## Cherokee County Water & Sewerage Authority

Fitzgerald Creek Water Pollution Control Plant

# PROJECT MANUAL

## FOR

## Fitzgerald Creek WPCP Thermal Dryer Facility

## November 2025

## BIDDING DOCUMENTS

## VOLUME 1 OF 4

## PROCUREMENT, CONTRACTING, AND GENERAL REQUIREMENTS

## DIVISIONS 00 THROUGH 01

Hazen

**SECTION 00 01 01**

**PROJECT TITLE PAGE**

# PROJECT MANUAL

## FOR

## Fitzgerald Creek WPCP Thermal Dryer Facility

## November 9, 2025

**Professional Engineer Certifications**

Date: 2025.11.05 18:50:47-05'00'

Daniel D. Sebusch, PE

License No. PE030101
Divisions: 01, 02, 40-46

Date: 2025.11.05 18:53:08-05'00'

Daniel D. Sebusch, PE

License No. PE030101
Divisions: 31-33

Date: 2025.11.05 19:37:18-05'00'

Frederick P. Powell, PE

License No. SE000116
Divisions: 03-05, 13

2025.11.05 19:41:11-05'00'

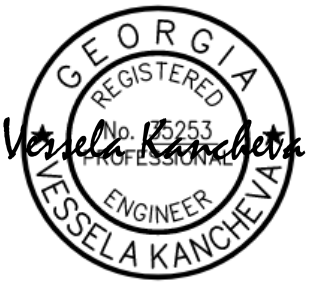
Jared C. Stanbridge, PE

License No. PE045672
Divisions: 40

Date: 2025.11.06 08:42:02-05'00'

Timothy L. Monahan, PE

License No. PE045504
Divisions: 21-23




2025.11.05 20:38:12-05'00'

Vessela Kancheva, PE

License No. PE35253
Divisions: 26, 28

Andrew Michael Queen
2025.11.06 08:48:08-05'00'

Andrew M. Queen, RA

License No. RA017598
Divisions: 06-12

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CHEROKEE COUNTY WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WATER POLLUTION CONTROL PLANT

FITZGERALD CREEK WPCP THERMAL DRYER FACILITY

## ADVERTISEMENT FOR BIDS

PROJECT: FITZGERALD CREEK WPCP THERMAL DRYER FACILITY
SEALED BIDS WILL BE RECEIVED AT: ***110 RAILROAD STREET, CANTON, GA 30114***
UNTIL: ***DECEMBER 17, 2025 AT 2 P.M., LOCAL TIME***

***COREY GHORLEY, CHEROKEE COUNTY WATER & SEWERAGE AUTHORITY***

Sealed Bids for the construction of the indicated project will be received by the Cherokee County Water & Sewerage Authority, at which time the Bids received will be publicly opened and read at that time and location. Bids received after the designated time will not be considered. Unsealed Bids, including facsimile Bids or Bids sent by e-mail, will not be considered. The Engineer for the project is Hazen and Sawyer.

Bid opening time is subject to extension pursuant to O.C.G.A. § 36-91-20(d).

Bidders shall inform themselves concerning Georgia Laws and comply with same.

The Work is located at the Fitzgerald Creek Water Pollution Control Plant located at 260 Colemans Bluff Drive, Woodstock, GA 30188. The Work includes, but is not limited to, furnishing of the labor, materials, and equipment for the construction and start-up of the following:

- Construction of new Thermal Dryer Facility
- Construction of new Final Effluent Water Pump Station
- Modifications to existing Solids Electrical Building
- Modifications to existing Compressor Building
- Modifications to existing Dewatering Building No. 1 and No. 2
- Associated site work, including site civil, site piping, stormwater control, and site electrical work

- Associated structural work for new and existing facilities

- Associated electrical and instrumentation and controls for new and existing facilities

The time allowed for Substantial Completion is **730** consecutive calendar days, and the time allowed for final completion and readiness for final payment is **775** consecutive calendar days from the date of commencement. Additional interim milestones are identified in the Agreement.

The Work will be awarded in one Contract.

A mandatory Pre-Bid Conference will be held for all Bidders beginning at 9 a.m., local prevailing time, on November 19, 2025, at the Fitzgerald Creek WPCP Maintenance Shop, 260 Colemans Bluff Drive, Woodstock, GA 30188. A Bid submitted by a Bidder not having attended the entire Pre-Bid Conference will not be opened.

In addition, a non-mandatory Plant Visitation Day will be held immediately after the Pre-Bid Conference for potential Bidders to better acquaint themselves with the Fitzgerald Creek WPCP. The purpose of the Plant Visitation Day will NOT be to respond to specific questions related to the Project. Additional visits to the site may be allowed and will be by appointment only; requests for additional visits should be sent to Cherokee County Water & Sewerage Authority, Roy Hostetler, at least 3 working days in advance of the requested visit (Roy.Hostetler@cherokeewaterga.gov or via telephone at 470-302-9948).

The Instructions to Bidders, Bid, Contract Agreement, Drawings, Specifications, and forms of Bid Bond, Performance Bond, Payment Bond, and other Contract Documents may be examined at the following, via appointment only:

Cherokee County Water & Sewerage Authority
110 Railroad Street
Canton, Georgia 30114
Attn: Corey Ghorley
Email: coreyghorley@cherokeewaterga.gov
Phone: 770-479-1813, Ext. 1183

Hazen and Sawyer
1300 Altmore Avenue, Suite 520
Atlanta, Georgia 30342
Attn: Taylor Jones
Email: tjones@hazenandsawyer.com
Phone: 404-459-6363

The Instructions to Bidders contains technical experience requirements associated with determining a Bidder is being responsible. To obtain a copy of such experience requirements free of charge prior to purchasing the Contract Documents, one may contact Taylor Jones at 404-459-6363.

All questions related to the Project shall be submitted by email no later than 5 p.m., local time, on **December 3, 2025**, to Dan Sebusch, PE at dsebusch@hazenandsawyer.com. Questions, if answered, will be addressed by addendum to the Contract Documents. Receipt of any amendment to this Advertisement for Bids shall be acknowledged, in writing, and shall be submitted with the Bid.

Electronic copies of Contract Documents (including information of record) are available as a download from **QuestCDN at www.questcdn.com (Issuing Office)** upon payment of $22.00,

non-refundable. Reference Quest Number: 9907823. Prior to downloading the Contract Documents, purchasers will be required to set up a www.QuestCDN.com account. All Bidders are required to purchase a set of the Contract Documents. Hard copies of the Contract Documents are the responsibility of the purchasers. Contact QuestCDN at 952-233-1632 or info@questcdn.com for assistance with navigating the website and digital project information.

By purchasing the Contract Documents, purchaser agrees to allow company information (company name, address, phone and fax numbers) to be published as a planholder. The Owner is not obligated to consider a Bidder's proposal if Bidder is not on record with the Issuing Office as having received a complete set of Bidding Documents from the Issuing Office.

A list of planholders may be obtained from QuestCDN at www.questcdn.com (reference Quest Number: 9907823).

All Bids must be made out on the bid form to be obtained from the Engineer with the contract documents, in accordance with the Instructions to Bidders. No interlineations, additions or deletions shall be made in the bid form by the Bidder.

Each Bid must be accompanied by a Bid Bond with good and sufficient surety or sureties approved by the Owner for faithful acceptance of the contract, payable to, in favor of, and for the protection of the Owner in an amount equivalent to 5 percent of the total amount payable by the terms of the contract or, in lieu thereof, a certified check, cashier's check, or cash in equal amount. The Bid Bond shall be prepared on the Bid Bond form attached to the Contract Documents or a Surety Company's Standard Bid Bond, duly executed by the Bidder as principal and having as Surety thereon a surety company licensed to do business in the State of Georgia and listed in the latest issue of U.S. Treasury Circular 570.

Each Bid must also be accompanied by a notarized Non-Collusion Affidavit of Bidder, Contractor’s License Certification, Statement of Bidder’s Qualifications, and Security and Immigration Compliance Act Certification. Out-of-state corporations and other entities must submit evidence of authority to conduct business in Georgia as an out-of-state entity.

Each Bidder must be a State of Georgia licensed Utility Contractor at the time of the Bid.

The successful Bidder must employ and assign to the Project supervisory personnel trained and state certified at Level 1A – Fundamentals of the Georgia Erosion and Sediment Control training program.

The Owner will in no way be liable for any costs incurred by any Bidder in the preparation of its Bid in response to this Advertisement for Bids.

The successful Bidder will be required to furnish a Performance Bond, Payment Bond, Certification of Contractor’s Attorney, and Contractor’s Agreement with the executed Agreement meeting the requirements of the Contract Documents and executed on the forms attached to the Agreement. The successful Bidder will also be required to furnish the Pre-Construction Oath pursuant to O.C.G.A. § 36-91-21 from every person who procures the Agreement. The successful Bidder shall also provide an executed Subcontractor Affidavit for each subcontractor

working on the Project, using the form attached to the Agreement; Subcontractor Affidavits shall be submitted to the Cherokee County Water & Sewerage Authority as each subcontractor is brought under contract during execution of the Project. The terms and time for payment are set forth in the Agreement.

All Bids will remain subject to acceptance for 90 days after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.

The Owner reserves the right to reject all Bids, to waive informalities and re-advertise.

**Cherokee County Water & Sewerage Authority**

**Corey Ghorley**

**Capital Improvement Coordinator**

**END OF ADVERTISEMENT FOR BIDS**

**SECTION 00 20 00**

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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 which are applicable to both the singular and plural thereof.

A. Bidder: One who submits a Bid directly to Owner as distinct from a sub-bidder, who submits a bid to a Bidder

B. Issuing Office: The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered is Hazen and Sawyer, Atlanta office at 1300 Altmore Avenue, Suite 520, Atlanta, GA 30342

C. Bidding Documents Holder: A party recorded by Engineer as having obtained the Bidding Documents as required by the Advertisement for Bids

D. Successful Bidder: The lowest, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award

E. Owner: Cherokee County Water & Sewerage Authority (CCWSA), party of the first part to the Contract Agreement, or its authorized and legal representatives

F. Engineer: Hazen and Sawyer

G. Engineer’s Consultant: Geo-Hydro Engineers, Inc. and TerraMark Land Surveying, Inc.

H. Contractor: The party of the second part to the Contract Agreement or the authorized and legal representative of such party

I. Work and Project: Shall mean the entire completed construction required to be furnished under the Contract Documents

J. Products: Shall mean materials or equipment permanently incorporated into the Project

K. Provide: Shall mean to furnish and install

## ARTICLE 2 – BIDS RECEIVED

2.01 Refer to the Advertisement for Bids for information on receipt of Bids.

## ARTICLE 3 – LOCATION AND DESCRIPTION OF PROJECT

3.01 Refer to Section 01 11 00 – Summary of Work in the General Requirements for the location and description of the Project.

## ARTICLE 4 – COPIES OF BIDDING DOCUMENTS

4.01 Refer to the Advertisement for Bids for information on location where Bidders may examine and obtain the Bidding Documents.

4.02 Bids will only be opened from Bidders who have purchased a complete set of the Bidding Documents. Refer to Section 00 11 00 - Advertisement for Bids for information on purchasing the documents.

4.03 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

4.04 Owner and Engineer in making copies of Bidding Documents available on the previously listed terms do so only for the purpose of obtaining Bids for the Work and do not grant permission for any other use.

## ARTICLE 5 – QUALIFICATIONS OF BIDDERS

5.01 Owner reserves the right to reject any Bidder who does not satisfy the Owner as to its ability to successfully perform the Work.

5.02 To demonstrate current qualifications to perform the Work, Bidder shall complete and submit with its Bid the Statement of Bidder’s Qualifications (Section 00 42 00). Bidders may be asked to and shall furnish additional data to demonstrate Bidder's qualifications.

5.03 The Bidder will be required to provide evidence of compliance with the requirements of O.C.G.A. § 43-14 and O.C.G.A. § 43-41 (Construction Industry Licensing Board Acts and Rules and Regulations) with respect to the requirements of the code.

5.04 Bidder shall be a licensed Utility Contractor in the State of Georgia at the time Bids are submitted. Contractors and subcontractors must be licensed by the State Construction Industry Licensing Board, GA Rules & Regulations 121-6.02.

5.05 Each Bidder must be a Bidding Document Holder. Bids submitted by Bidders not on the list of Bidding Documents (Plan) Holders will not be opened.

5.06 The Owner may make such investigations as it deems necessary to determine the ability of the Bidder to perform the work and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request, including information on subcontractors that are intended to perform work on the project. By submission of his Bid the Bidder acknowledges the right of the Owner to make such investigations, to contact references and utilize this information as a basis of determining award of the contract. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein.

5.07 The minimum experience criteria to be considered a responsible Bidder are as follows:

A. Satisfactory completion of four municipal water treatment plant or wastewater treatment plant projects, with at least two projects being a municipal wastewater treatment plant.

1. These projects must have been performed by the Applicant, as a corporation, under a direct contract with a municipal utility.

2. The scope of each of these projects must have been to perform upgrades or expansions at existing plants.

3. At least two of these projects must have a construction contract amount of at least $15,000,000, and two projects must have a construction contract amount of at least $20,000,000.

4. Each of these projects must have been completed as of October 1, 2025, and within the past 10 years.

5. At least 50 percent of the labor-related items on each project must have been completed by the Applicant's own work force and not by temporary or contract personnel.

B. Key Personnel: The Bidder must demonstrate that the proposed Project Manager and Project Superintendent shall meet the following criteria: The proposed Project Manager and the proposed Project Superintendent shall have been involved in a similar role in at least one of the listed projects described in Paragraph 5.07, A herein and at least two projects with a construction cost of $20,000,000 or greater. Key personnel identified in the Statement of Bidder’s Qualifications shall be assigned to this project.

C. Adequate demonstration of the previously listed project qualifications for the Bidder and specialty subcontractor, if required, shall be provided at the time of bid on the Statement of Bidder’s Qualifications form contained in these Specifications with accompanying company resumes, marketing brochures and individual project descriptions as required. Current reference names and contact telephone numbers shall be provided at the time

of bid for the listed projects. Adequate demonstration of the qualification of the proposed Project Manager and Project Superintendent shall be provided at the time of bid in the form of personnel resumes.

D. The Bidder shall, as a part of its Bid, submit a list of similar projects it has successfully completed with a contact reference for each project. The contact reference shall be a current employee of the owner of that project. The Bidder shall also provide, for the projects mentioned above and the proposed Project Superintendent, any history of litigation, arbitration, or other related mediation actions. All project experience information shall be required to be notarized.

E. If Bid is submitted by a joint venture, all parties to the joint venture must individually satisfy the minimum experience criteria outlined herein in Paragraph 5.07.

## ARTICLE 6 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA AND SITE

6.01 Subsurface and Physical Conditions

A. Supplementary Conditions identify:

1. Reports of explorations and tests of subsurface conditions at or contiguous to the Site that have been utilized by Engineer in preparation of the Bidding Documents. Bidder may rely upon the general accuracy of the “technical data” contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the Site, nor upon the completeness thereof for the purposes of bidding or construction.

2. Drawings of physical conditions relating to existing surface or subsurface structures (except Underground Facilities), which are at or contiguous to the Site, that have been utilized by Engineer in preparation of Bidding Documents. Bidder may rely upon the general accuracy of the “technical data” contained in such drawings but not upon other data, interpretations, opinions or information shown or indicated in such drawings or otherwise relating to such structures, nor upon the completeness thereof for the purposes of bidding or construction.

3. Copies of such reports and drawings will be made available for review to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the “technical data” contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion drawn from any “technical data” or any such data, interpretations, opinions or information.

6.02 Underground Facilities – Physical Conditions

A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others. Owner and Engineer do not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

6.03 Hazardous Environmental Condition

A. Owner has no actual knowledge of a Hazardous Environmental Condition at the Site.

6.04 Provisions concerning responsibilities for the adequacy of data, furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unforeseen subsurface or physical conditions appear in Paragraphs 4.02, 4.03, 4.04 and 4.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work appear in Paragraph 4.06 of the General Conditions.

6.05 Other Related Data (Not Used)

6.06 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a Bid. Bidder shall fill all holes and clean up and restore the Site to its original conditions upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all Laws and Regulations relative to such explorations, investigations, tests, and studies.

A. On request, Owner will conduct a Site visit during Owner's normal business hours. Contact Roy Hostetler at Roy.Hostetler@cherokeewaterga.gov or 470-302-9948 to schedule. Requests shall be made at least 3 working days in advance of proposed Site visit and at least 5 days prior to opening of Bids.

B. Owner will conduct a Site walkthrough during the Pre-Bid Conference.

6.07 Reference is made to Section 01 11 00 – Summary of Work for identification of the general nature of other work to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work for which a Bid is to be submitted. On request, Owner will provide to Bidder, for examination, access to or copies of the contract documents for such other work.

6.08 It is the responsibility of Bidder, before submitting a Bid to:

A. Examine and carefully study the Bidding Documents, the other related data identified in the Bidding Documents and Addenda (including “technical data” referred to below);

B. Visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance or furnishing of the Work;

C. Become familiar with and satisfy Bidder as to the Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work;

D. To study and carefully correlate the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in Bidding Documents, including “technical data,” with respect to the effect of such information, observation, and documents on:

1. The cost, progress and performance of the Work;

2. The means, methods, techniques, sequences and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences and procedures of construction expressly required by the Bidding Documents; and

3. Bidder’s safety precautions and programs;

E. Agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for the performance of the Work at the price(s) bid and within the times required and in accordance with the other terms and conditions of the Bidding Documents;

F. Become aware of the general nature of work (if any) to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

G. Promptly give Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

H. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

6.09 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 6, that without exception the Bid is premised upon performing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, or procedures of construction that may be shown or indicated or expressly required by the Bidding

Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing the Work.

## ARTICLE 7 – PRE-BID CONFERENCE.

7.01 **A MANDATORY Pre-Bid Conference** will be held at 9 a.m. local time on November 19, 2025, at the Fitzgerald Creek WPCP Maintenance Shop, 260 Colemans Bluff Drive, Woodstock, GA 30188. Representatives of Owner and Engineer will be present to discuss the Project. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions raised at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

## ARTICLE 8 – SITE AND OTHER AREAS

8.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment, to be incorporated into the Work are to be obtained and paid for by Contractor.

## ARTICLE 9 – INTERPRETATIONS AND ADDENDA

9.01 All questions about the meaning or intent of the Bidding Documents shall be submitted to Engineer in writing. Every request for such interpretation and all questions must be made by email to Hazen and Sawyer, attention: dsebusch@hazenandsawyer.com. No questions shall be sent directly to the Owner. To receive consideration, questions must be received by Engineer at least 14 calendar days prior to the date for the opening of Bids. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents for receipt not later than 3 business days prior to the date for the opening of Bids. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

9.02 Addenda may also be issued to clarify, correct or change the Bidding Documents as deemed advisable by Owner or Engineer. Such Addenda, if any, will be issued in the

manner and within the time period stated in Paragraph 9.01 of these Instructions to Bidders.

A. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

B. Failure of any Bidder to receive any such addendum or interpretations shall not relieve such bidder from any obligation under his Bid as submitted.

C. Failure of any Bidder to acknowledge any such addendum or interpretations shall not relieve such Bidder from any obligation under his Bid as submitted, if Bidder has knowledge of any such addendum or interpretations. If Bidder has knowledge of any such addendum or interpretation but fails to acknowledge, this will be considered an informality.

## ARTICLE 10 – BID SECURITY

10.01 Bids shall be accompanied by either a Bid Bond (on the form attached) for the full amount of the Bid issued by a bonding company authorized to do business in the state of Georgia, for faithful acceptance of the contract, payable to, in favor of, and for the protection of the Owner in an amount equivalent to five percent (5%) of the total amount payable by the terms of the contract, in lieu thereof, in the form of a certified check, cashier's check, or cash in equal amount. Bidders who submit Bid Security in the form of a certified check, cashier's check, or cash are bound by the “Terms of Bid Bond” as if submitted on the attached “Bid Bond” form.

10.02 Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement, furnished the required contract security and Certifications of Insurance, and complied with the other conditions of the Notice of Award, whereupon the bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within **15 days** of the Notice of Award, Owner may annul the Notice of Award and the bid security of that Bidder will be forfeited.

10.03 Bid Security of the three lowest Bidders may be retained by Owner until the earlier of the seventh (70th) day after the execution of the Agreement by the Successful Bidder or the sixtieth (60th) day after the Bid opening. The bid Security of other Bidders will be returned within 7 days of the Bid opening.

10.04 Failure of Bidder to provide qualification information, if requested, within 10 days of notification of request, shall be grounds for forfeiting of the Bid Security of that Bidder.

## ARTICLE 11 – CONTRACT TIMES

11.01 The number of days within which or the dates by which the Work is to be substantially completed and also completed and ready for final payment (the Contract Times) are set forth in the Agreement and incorporated therein by reference in the attached Bid Form.

## ARTICLE 12 – LIQUIDATED AND SPECIAL DAMAGES

12.01 Provisions for liquidated and special damages, if any, are set forth in the Agreement.

## ARTICLE 13 – SUBSTITUTE AND "OR EQUAL" ITEMS

13.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items which have not received approval of the Engineer. Whenever it is specified or described in the Bidding Documents that a substitute or "or equal" item of material or equipment may be furnished or used by Contractor if accepted by Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submittal of any such application by Contractor and consideration by Engineer is set forth in the General Conditions which may be supplemented in the General Requirements (Division 01).

13.02 Refer to Section 01 25 00 – Substitution Procedures, of the General Requirements for the period of time after the Effective Date of the Agreement during which the Engineer will accept applications for substitute items of material or equipment.

## ARTICLE 14 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

14.01 The Bid Form contains a Certified List of Subcontractors. Bidder shall indicate the name of the Subcontractor that will be used in the performance of work on the Project for each area of specialization listed. The Subcontractor for Instrumentation and Controls Integration Services is defined in this list and shall not be changed.

14.02 The Bid Form contains an Equipment Manufacturer/Supplier Schedule for the Bidder to indicate which manufacturer/supplier the Bid is based on. Bidder shall circle the supplier for each of the grouped sections to indicate which suppliers have been used as part of the Bidder's Lump Sum Price. The Bid Form allows for alternate manufacturers/suppliers to be proposed for certain equipment. The Bidder shall adhere to the requirements stated in the Bid Form for indicating the manufacturer/supplier for each equipment item that will be used in the Project as well as any proposed alternates.

## ARTICLE 15 – PREPARATION OF BIDS

15.01 A Bid shall be made on the Bid Form bound in Project Manual. The Bid Form shall not be separated from the Bid Submittal Document nor shall it be altered in any way. The entire Bid Submittal Document must be submitted. Only the completed Bid Submittal Document is required to be submitted.

15.02 All blanks in the Bid Form shall be completed in ink or by a typewriter and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each Bid Item listed therein. In the case of optional alternatives, the words “No Bid”, “No Change”, or “Not Applicable” may be entered. Ditto marks shall not be used.

15.03 A Bid shall be executed as stated below.

A. A Bid by an individual shall indicate the Bidder’s name and official address.

B. A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title shall appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be indicated.

C. A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be indicated.

D. A Bid by a corporation shall be executed in the corporate name by an officer of the corporation and shall be accompanied by a certified copy of a resolution of the board of directors authorizing the person signing the Bid to do so on behalf of the corporation. The corporate seal shall be affixed and attested by the secretary or an assistant secretary of the corporation. The state of incorporation and the official corporate address shall be indicated.

E. A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be indicated below the signature.

F. All names shall be typed printed in ink below the signature.

G. If applicable, the Bid shall contain evidence of Bidder’s authority and qualification to do business in the state of Georgia or Bidder shall agree in writing to obtain such authority and qualification prior to award of Contract and attach such statement to the Bid. State Utility Contractor license number must also be shown on the Contractor’s License Certificate.

15.04 Bid shall contain an acknowledgment of the receipt of all Addenda, the numbers of which shall be filled in at the space provided on the Bid Form.

15.05 Postal and email addresses and telephone number for communications regarding the Bid shall be indicated.

15.06 The following listed documents are the Bid Submittal Document, and one original copy of each document shall be submitted with the Bid. Each document shall be executed in the manner described in Paragraph 15.03 unless another manner is indicated.

A. Bid Form (Section 00 40 00 – Bid Form)

B. Bid Bond: The required bid security in the form of bid bond, certified check, cashier's check or cash must be included and attached to the Bid Bond form. Bidders who submit Bid Security in the form of a certified check, cashier's check or cash are bound by the "Terms of Bid Bond".

C. Statement of Bidder’s Qualifications

D. Corporate Certificate

E. Contractor’s License Certification

F. Security and Immigration Compliance Act Certification

G. Subcontractor Affidavit(s)

H. Non-Collusion Affidavit of Bidder

I. Any other documents required for a complete, responsive, and responsible Bid

## ARTICLE 16 – BASIS OF BIDS; COMPARISON OF BIDS

16.01 Single Lump Sum

A. Bidder shall submit Bid on the basis of single lump sum as set forth in the Bid Form. Bidder shall include pre-negotiated costs for sole-sourced equipment and services, unit price work, and cash allowances as set forth in the Bid Form and as described in Section 01 20 00 – Measurement and Payment.

16.02 Discrepancies between words and numerals will be resolved in favor of words. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

16.03 Bidder shall include, elsewhere in Bid, costs set forth in Paragraph 11.02.B of the General Conditions to complete the Work associated with the material, equipment, or other designated items to be furnished under cash allowance(s).

## ARTICLE 17 – SUBMITTAL OF BID

17.01 A Bid shall be received no later than the date and time prescribed and at the place indicated in the Advertisement for Bids.

17.02 Bid shall be enclosed in an opaque sealed envelope plainly marked on the outside with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of the Bidder and its Utility Contractor License number. Bid shall be accompanied by Bid Security and other required documents.

17.03 If the Bid is sent by mail or other delivery method, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "BID ENCLOSED". A mailed Bid shall be addressed to the same address as indicated in the Advertisement for Bids.

17.04 Within 3 business days after the Bid Opening date, Bidder shall submit Electrical Subcontractor Statement of Qualifications, Electrical Subcontractor Affidavit Under O.C.G.A. § 13-10-91 (b)(3) (if applicable), and Instrumentation and Control System Programmer Subcontractor Affidavit Under O.C.G.A. § 13-10-91 (b)(3) (if applicable).

17.05 Any Bid which is not properly prepared and accompanied by required certifications may be rejected by the Owner.

## ARTICLE 18 – MODIFICATION OR WITHDRAWAL OF BID

18.01 Withdrawal Prior to Bid Opening:

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

18.02 Modification Prior to Bid Opening:

A. If a Bidder wishes to modify its Bid, Bidder must withdraw its initial Bid in the manner specified in Paragraph 18.01.A of these Instructions to Bidders and submit a new Bid.

## ARTICLE 19 – OPENING OF BIDS

19.01 Bids will be opened at the time and place where Bids are to be submitted and, unless obviously non-responsive, read aloud publicly at the place where bids are to be submitted. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Bidders after the opening.

19.02 Bids received by mail or otherwise after the date and time specified for the opening of Bids will not be accepted and will be returned to the Bidder unopened.

## ARTICLE 20 – DISQUALIFICATION OF BIDDERS

20.01 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

## ARTICLE 21 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

21.01 All Bids shall remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid Security prior to the end of that period. Owner will release any Bid and return the Bid Security if a Bidder requests the withdrawal of its Bid and basis of withdrawal is in accordance with O.C.G.A. § 36-91-52.

## ARTICLE 22 – EVALUATION OF BIDS AND AWARD OF CONTRACT

22.01 Owner reserves the right to reject any or all Bids, including without limitation the right to reject any or all nonconforming, nonresponsive, unbalanced, or conditional Bids and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to be not responsible. Owner also reserves the right to waive any informality not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder. In the event a Bid is rejected by Owner or a Bidder is permitted by Owner to withdraw its Bid, Owner reserves the right to preclude such Bidder from resubmitting a Bid at any subsequent re-bidding of the Work.

22.02 Owner reserves the right to reject any Bid not accompanied by specified documentation and Bid Security.

22.03 Owner reserves the right to reject any Bid that, in its sole discretion, is considered to be unbalanced or unreasonable as to the amount bid for any lump sum or unit price item.

22.04 In evaluating Bidders, Owner will consider the qualifications of Bidders, whether or not their Bids comply with the prescribed requirements, the alternatives, if any, the lump sum and unit prices, and other data as may be requested in the Bid Form or prior to the Notice of Award. Conditional Bids will not be accepted.

22.05 Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating

costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

22.06 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of the Bidders to perform the Work in accordance with the Contract Documents and to assist in the evaluation of any Bid. Owner reserves the right to reject the Bid of any Bidder who does not pass any such evaluation to Owner's satisfaction.

22.07 Owner reserves the right to reject any and all Bids, to waive any informalities or irregularities, and further, reserves the right to accept any Bids or parts of Bids. Owner reserves the right to accept any Bid deemed to be in its best interests even though the Bid chosen may result in the award of the Contract to a Bidder whose Bid is not, on a mathematical basis alone, the low Bid.

22.08 If a Contract is to be awarded, Owner will award the Contract to the lowest responsive, best, and responsible Bidder who has neither been disqualified nor rejected pursuant to Article 20 of the Instructions to Bidders or this Article 22.

22.09 If the Contract is to be awarded, Owner will give Successful Bidder a Notice of Award within 90 days after the day of the Bid opening.

## ARTICLE 23 – CONTRACT SECURITIES

23.01 Performance and Payment Bond shall be in the full amount of the Bid. If a Bidder submitted an acceptable Bid Guaranty and Contract Bond with its Bid, a Performance and Payment Bond is not required. The amounts of and other requirements for Performance and Payment Bonds are stated in Paragraph 5.01 of the General Conditions and the Supplementary Conditions. The requirements for delivery of Bonds are stated in Paragraph 2.01 of the General Conditions. Additional requirements may be stated in the Supplementary Conditions.

## ARTICLE 24 – CONTRACTOR'S INSURANCE

24.01 The requirements for Contractor's insurance are stated in Article 5 of the General Conditions and in the Supplementary Conditions. The requirements for delivery of certificates of insurance and other evidence of insurance are stated in Paragraph 2.01.B of the General Conditions.

24.02 Successful Bidder shall within 15 days from the date of the Notice of Award deliver to Owner, for review and approval, the required policies of insurance. Upon approval, the policies will be returned to the Bidder and Bidder shall submit certificates of insurance and other evidence of insurance to the Owner as stated in the General Conditions.

## ARTICLE 25 – SIGNING OF AGREEMENT

25.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner with the required Bonds and Certification of Insurance. Within 15 days of the Owner's receipt from the Contractor of the following documents in proper form: the required number of executed counterparts of the Agreement, the Bonds, the oath pursuant to O.C.G.A. § 36-91-21(e), the Certification of Insurance, and any other documents required by the Bidding Requirements, Owner will deliver one fully signed counterpart to the Contractor.

## ARTICLE 26 – NOTICE TO PROCEED

26.01 Issuance of the Notice to Proceed shall be as stated in Article 2 of the General Conditions.

## ARTICLE 27 – SALES AND USE TAXES

27.01 Refer to Paragraph 6.10 in Section 00 72 00 – General Conditions.

## ARTICLE 28 – ADDITIONAL REQUIREMENTS

28.01 The Bidder to whom the Contract is awarded shall disclose in writing the knowledge of any business relationship or interest that any Owner employee, an employee's immediate family, or any other contractor or subcontractor of said Successful Bidder may have with the Successful Bidder.

28.02 Laws and Regulations

A. All applicable federal and state laws, municipal ordinances, and rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

28.03 Permits and Easements

A. All anticipated federal, state, and local permits which are required for the Project and which are the responsibility of the Owner have been obtained, except as follows:

Georgia EPD Plans and Construction Specifications Approval: This permit is anticipated to be completed prior to commencement of Construction.

Cherokee County permitting review approval: This approval is anticipated to be completed prior to bidding.

B. All Cherokee County Building and Land Disturbance Permits and associated fees are the responsibility of the Contractor.

C. Final payment shall not be issued to the Contractor until all permits obtained by the Contractor have been properly closed with the issuing agency and copies of close-out documentation have been provided by the Contractor to the Owner.

28.04 Security and Immigration Act

A. Contractors and Subcontractors who enter into contracts with public employers are required to register and participate in the Federal Work Authorization Program to verify work eligibility information of new employees. Bidders are required to fill out the following forms located in the Bidding Documents attesting to their status under this program and that they will pass on the same requirements to their Subcontractors as required by O.C.G.A. § 13-10-90, § 13-10-91, and GA Department of Labor 300-10-1:

Security and Immigration Compliance Act Certification

B. Pursuant to Code of Georgia 13-10-90 et. seq., and the Georgia Security and Immigration Compliance Act of 2006, the following forms located in the Bidding Documents shall be completed prior to Award:

Contractor Agreement

Subcontractor Affidavit (if applicable)

Sub-Subcontractor Affidavit (if applicable)

C. Contractor understands and agrees that compliance with the requirements of O.C.G.A. § 13-10-90, O.C.G.A. § 13-10-91, and Georgia Department of Labor Rule 300-10-1 are conditions of this Agreement.

D. Contractor further agrees that such compliance shall be attested by Contractor and its Subcontractors by execution of the appropriate Agreement and Subcontractor Affidavit forms (if applicable) included in the Contract Documents.

**END OF INSTRUCTIONS TO BIDDERS**

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**SECTION 00 40 00**

**BID FORM**

**TABLE OF ARTICLES**


1. Bid Recipient
2. Bidder's Acknowledgements
3. Bidder's Representations
4. Bidder's Certifications
5. Basis of Bid
6. Certified List of Subcontractors
7. Certification of Equipment/Materials Manufacturers
8. Time of Completion
9. List of Required Attachments to this Bid
10. Defined Terms
11. Bid Submittal


**ARTICLE 1 – BID RECIPIENT**

1.01 This Bid is submitted to:

Cherokee County Water & Sewerage Authority
Attention: Corey Ghorley
110 Railroad Street
Canton, Georgia 30114

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 price(s) and within the times indicated in this Bid and in accordance with the Bidding Documents.

## ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Advertisement for Bids and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner. Bidder will sign the Agreement and will furnish the required contract security, and other required documents within the time periods set forth in the Bidding Documents.

## ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, other related data identified in the Bidding Documents, if any, and the following Addenda, receipt of all of which is hereby acknowledged.

| Addendum No. | Date Received | Addendum No. | Date Received |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, performance, and furnishing of the Work, and bidder has not relied upon any oral representations by employees or agents of Owner or Engineer.

C. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, performance, and furnishing of the Work.

D. Bidder has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities), if any, that have been identified in have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions as containing reliable "technical data". Bidder acknowledges that such reports and Drawings are not Contract Documents and may not be complete for Bidder's purposes. Bidder acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of

information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the Site.

E. Bidder has considered the information known to Bidder, information commonly known to contractors doing business in the locality of the Site, information and observations obtained from visits to the Site, the Bidding Documents, and the Site-related reports and drawings identified in the Bidding Documents with respect to the effect of such information, observations, and documents on:

1. The cost, progress and performance or furnishing of the Work

2. The means, methods, techniques, sequences and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder

3. Bidder's safety precautions and programs

F. Based on the information and observations referred to in Paragraph 3.01.E, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work (if any) to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

I. Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

## ARTICLE 4 – BIDDER'S CERTIFICATIONS

4.01 Bidder certifies that:

A. This Bid is genuine and is not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive or coercive practices in competing for the Contract. For the purposes of the Paragraph 4.01.D.

1. “Corrupt practice” means the offering, giving, or soliciting of anything of value likely to influence the action of a public official in the bidding process

2. ”Fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

3. “Collusive practice” means to 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.

4. “Coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

**ARTICLE 5 – BASIS OF BID**

5.01 Bidder will complete the Work in accordance with the Contract Documents for the amount as listed below. Total bid amount(s) shall be shown in words and numbers. In case of discrepancy, the bid amount shown in words will govern.

A. ITEM 1 - LUMP SUM WORK: Furnishing all products, materials and equipment and performing all labor necessary to complete and put into operation the Fitzgerald Creek WPCP Thermal Dryer Facility Project, including all Work shown on the Drawings and/or specified, excluding PRE-NEGOTIATED COSTS FOR SOLE-SOURCED EQUIPMENT AND SERVICES (ITEM 2), CASH ALLOWANCES (ITEM 3), and UNIT PRICE WORK (ADDITIONAL WORK IF ORDERED BY ENGINEER) (ITEM 4), in the amount of:

_____

_____DOLLARS

($_____).
(Numerals)

B. ITEM 2 - PRE-NEGOTIATED COSTS FOR SOLE-SOURCED EQUIPMENT AND SERVICES

| Item No. | Specification Section No.* | Equipment Item | Supplier | Cost |
|---|---|---|---|---|
| 2.1 | 46 76 70 | Indirect Thermal Sludge Drying System | BCR Environmental | $11,545,582.00 |
| **TOTAL PRE-NEGOTIATED EQUIPMENT/SERVICES COST** | | | | **$11,545,582.00** |

* Refer to the referenced Specification Section No.(s), which include the Proposal from each Manufacturer/Provider/Supplier regarding scope to be provided under each sole-source equipment and services bid item at the cost indicated. Contractor shall be responsible for compliance with all requirements of the Contract Documents for all equipment and services provided under said sole-source equipment and services bid item.

C. ITEM 3 - CASH ALLOWANCES

| Item No. | Description | Allowance |
|---|---|---|
| 3.1 | Owner Directed Work Items | $800,000.00 |
| **TOTAL CASH ALLOWANCES** | | **$800,000.00** |

D. ITEM 4 - UNIT PRICE WORK (ADDITIONAL WORK IF ORDERED BY THE ENGINEER)

| Item No. | Description | Approx. Quantity | Units | Unit Price | Extended Price |
|---|---|---|---|---|---|
| 4.1 | Additional Mill and Resurface | 400 | SY | $ | $ |
| 4.2 | Additional Asphalt, Full Depth | 200 | SY | $ | $ |
| 4.3 | Additional Concrete Paving, Full Depth | 200 | SY | $ | $ |
| 4.4 | Additional Concrete Paving Trench Repair | 100 | SY | $ | $ |
| 4.5 | Additional Select Fill | 50 | CY | $ | $ |
| 4.6 | Additional Graded Aggregate Base (GAB) for Subgrade Select Fill | 40 | CY | $ | $ |
| 4.7 | Additional #57 Stone | 10 | CY | $ | $ |
| 4.8 | Additional Type I Separator Geotextile | 100 | SY | $ | $ |
| 4.9 | Additional No. 16 AWG Shielded, Twisted Pair Cables | 1,000 | LF | $ | $ |
| 4.10 | Additional No. 14 AWG Wires | 1,500 | LF | $ | $ |
| 4.11 | Additional 1” Rigid Galvanized Steel Conduits | 300 | LF | $ | $ |

| Item No. | Description | Approx. Quantity | Units | Unit Price | Extended Price |
|---|---|---|---|---|---|
| 4.12 | Additional 1” Schedule 40 Rigid Nonmetallic PVC Conduits | 500 | LF | $ | $ |
| 4.13 | Additional 1” PVC-Coated Rigid Galvanized Steel Conduits | 300 | LF | $ | $ |
| **TOTAL EXTENDED UNIT PRICE** | | | | | **$** |

TOTAL BASE BID PRICE (INCLUSIVE OF ITEMS 1 – 4): _____

_____

_____ ($_____).

**ARTICLE 6 – SUBCONTRACTOR SCHEDULE**

Identify the Subcontractors to be used in the performance of work to be done on said Project for the following trades. If the Bidder is licensed in and intends to self-perform a given trade, the Bidder’s name should be listed in the space for Subcontractor for that trade. Changes to this list after the Bid opening shall only be as approved by the Owner upon request by the Contractor or as required by the Owner based on upon review of Subcontractor’s qualifications.

| AREA OF SPECIALIZATION | SUBCONTRACTORS |
|---|---|
| HVAC | |
| Plumbing | |
| Fire Protection | |
| Electrical | |
| Painting | |
| Instrumentation and Control System | |

It is understood and agreed that, if awarded a Contract, the Contractor will not make any additions, deletions or substitutions to this certified list without the consent of the Owner.

## ARTICLE 7 – MAJOR EQUIPMENT MANUFACTURERS/SUPPLIERS

7.01 Major Equipment Schedule: The Bidder agrees to furnish and install, in accordance with the Contract Documents, all items of equipment listed in the Major Equipment Schedule as part of the Lump Sum price stated by the Bidder. All items on the Major Equipment Schedule shall be bid according to the following:

A. The Major Equipment Schedule designates major equipment items to be provided. The Bidder shall indicate which of the specified Manufacturer's/Supplier's Equipment it is offering to provide by circling one of the Named Manufacturers/Suppliers listed. A Named Manufacturer/Supplier for each identified major equipment item shall be circled, even if only one is specified. If the Bidder desires to propose a substitute for any Named Manufacturer/Supplier of a specified item, it shall circle the Named Manufacturer/Supplier it is offering to provide and also shall write in the space provided the name of the offered Substitute Manufacturer/Supplier, unless the words "No Substitutes" is listed in which case only the Named Manufacturer/Supplier shall be circled. Should a Substitute Manufacturer/Supplier be determined "not equal" in the Engineer's discretion, the Bidder must provide the Named Manufacturer/Supplier circled.

B. If none of the Manufacturers/Suppliers are circled for any of the product(s) listed below, the Owner reserves the right either to determine the Bidder non-responsive and reject the Bid or to designate the Manufacturer/Supplier of the product(s) to be provided. No increase in the Contract Price will be allowed should the Owner elect to designate the Manufacturer/Supplier of these product(s).

C. Design of this Project is based upon the named equipment/suppliers as listed in the Owner-Selected Equipment/Supplier Schedule. Should a Bidder propose an equipment/supplier alternate, he shall include in his Bid any and all additional construction costs associated with the alternate and reimbursement to the Owner for any incurred engineering redesign costs associated with the alternate. The Bid shall also include any paid-up licenses necessary for the use of the equipment if required by the manufacturer.

D. Should a proposed and circled write-in alternate be determined "not equal" by the Owner, or should no proposed alternate be indicated, then the Bidder must provide one of the named manufacturer/supplier listed in the Major Equipment Schedule.

**Major Equipment Schedule**

| Section Number | Equipment Name/Description | Manufacturer/Supplier (circle ONE for each equipment item) |
|---|---|---|
| 26 24 19 | Low-Voltage Motor Control Centers (MCC-26) | A. Square D Company<br>B. Allen-Bradley<br>C. ABB |

**Major Equipment Schedule**

| Section Number | Equipment Name/Description | Manufacturer/Supplier (circle ONE for each equipment item) |
|---|---|---|
| 26 29 23 | Low-Voltage Variable Frequency Motor Controllers | A. Square D Company<br>B. Rockwell Automation (Allen-Bradley)<br>C. ABB |
| 40 05 59.23 | Fabricated Stainless Steel Slide Gates | A. Fontaine-Aquanox Water Control Products<br>B. Hydro Gate (Mueller Co.)<br>C. Rodney Hunt Company (JASH USA)<br>D. RW Gate Company<br>E. Waterman<br>F. Whipps, Inc. |
| 43 25 13.10 | Wet Pit Submersible Solids-Handling Pumps | A. Xylem/Flygt<br>B. _____ (or equal) |
| 46 76 42 | Screw Conveyors | A. Jim Myers & Sons<br>B. WAM Inc. |

NOTE: BIDDER MUST CIRCLE A BASE BID MANUFACTURER FOR EACH EQUIPMENT ITEM.

## ARTICLE 8 – TIME OF COMPLETION

8.01 Bidder agrees that the Work will be substantially complete and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

8.02 Bidder accepts the provisions of the Agreement as to liquidated and special damages in the event of failure to complete the Work within the Contract Time(s) specified in the Agreement.

## ARTICLE 9 – ATTACHMENTS TO THIS BID

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

A. Bid Bond: The required bid security in the form of bid bond, certified check, cashier's check or cash must be included and attached to the Bid Bond form. Bidders who submit Bid Security in the form of a certified check, cashier's check or cash are bound by the "Terms of Bid Bond".

B. Statement of Bidder’s Qualifications

C. Corporate Certificate

D. Contractor's License Certification

E. Security and Immigration Compliance Act Certificate

F. Non-Collusion Affidavit of Bidder

G. Subcontractor Affidavit(s) and Sub-Subcontractor Affidavit(s) (these forms may be submitted by the successful Bidder after Notice of Award is issued but shall be provided prior to Sub-Contractor or Sub-Sub-Contractor performing any Work on the Project and made part of this Bid by reference)

H. Security and Immigration Compliance Act Certificate for all Subcontractors and all Sub-Subcontractors (these forms may be submitted by the successful Bidder after Notice of Award is issued, but shall be provided prior to Subcontractor or Sub-Subcontractor performing any Work on the Project and made part of this Bid by reference)

**ARTICLE 10 – DEFINED TERMS**

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

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

## ARTICLE 11 – BID SUBMITTAL

11.01 This Bid submitted on _____, 20___ by:

If Bidder is (pick one):

### AN INDIVIDUAL

Name: _____
(Typed or Printed)

By: _____
(Individual's Signature)

Doing business as: _____

License or Registration Number: _____

Business Address: _____

_____

_____

Phone No.: _____ Fax No.: _____

E-mail: _____

### A PARTNERSHIP

Partnership Name: _____

By: _____
(Signature of General Partner - Attach evidence of authority to sign)

Name: _____
(Typed or Printed)

License or Registration Number: _____

Business Address: _____

_____

_____

Phone No.: _____ Fax No.: _____

Partnership Name: _____

E-mail: _____

**CORPORATION**

Corporation Name: _____

_____
(State of Incorporation)

By: _____
(Signature – Attach evidence of authority to sign)

Name and Title: _____
(Typed or Printed)

(CORPORATE SEAL)

Attest _____
(Secretary)

License or Registration Number: _____

Business Address: _____

_____

_____

Phone No.: _____ Fax No.: _____

E-mail: _____

## LIMITED LIABILITY COMPANY

By: _____
(Firm Name)

_____
(State of Formation)

By: _____
(Signature of Member / Authorized to Sign)

_____
(Printed or Typed Name and Title of Authorized to Sign)
(Attach evidence of authority to sign.)

License or Registration Number: _____

Business Address: _____

_____

_____

Phone No.: _____ Fax No.: _____

E-mail: _____

## A JOINT VENTURE

Name of Joint Venture: _____

First Joint Venturer Name: _____

By: _____
(Signature of First Joint Venturer – Attach evidence of authority to sign)

Name (Typed or Printed): _____

Title: _____

Second Joint Venturer Name: _____

By: _____
(Signature of First Joint Venturer – Attach evidence of authority to sign)

Name (Typed or Printed): _____

Title: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation or limited liability company that is a party to the joint venture shall be in the manner indicated above).

Business Address: _____

_____

_____

Phone and fax numbers and address for receipt of communications to joint venture.

Phone No.: _____ Fax No.: _____

E-mail: _____

**END OF BID FORM**

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**SECTION 00 41 00**

**BID BOND**

**PENAL SUM FORM**

**BIDDER**:

**SURETY***:*

**OWNER***:*

Cherokee County Water & Sewerage Authority

140 West Main Street

Canton, Georgia, 30114

**BID**

BID DUE DATE: _____

PROJECT: Fitzgerald Creek WPCP Thermal Dryer Facility

The Project includes, but is not limited to, the following:

- Construction of new Thermal Dryer Facility
- Construction of new Final Effluent Water Pump Station
- Modifications to existing Solids Electrical Building
- Modifications to existing Compressor Building
- Modifications to existing Dewatering Building No. 1 and No. 2
- Associated site work, including site civil, site piping, stormwater control, and site electrical work
- Associated structural work for new and existing facilities
- Associated electrical and instrumentation and controls for new and existing facilities

**BOND**

BOND NUMBER _____

DATE: *(Not later than Bid Due Date):* _____

PENAL SUM: 5 PERCENT OF BASE BID _____

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the following terms hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

**TERMS OF BID BOND**

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.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents the executed Agreement required by the Bidding Documents, any Performance and Payment Bonds, and Certification of Insurance required by the Bidding Documents and Contract Documents.

3. This obligation shall be null and void if:

    a. 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, any Performance and Payment Bonds and Certification of Insurance required by the Bidding Documents and Contract Documents, or

    b. All bids are rejected by Owner, or

    c. 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 time for issuing Notice of Award including extensions shall not in the aggregate exceed 90 days from the Bid Due Date without Surety's written consent.

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

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

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

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

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

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

Witness as to Principal:

_____
*(signature)*

_____
Principal

By: _____(SEAL)
*(signature)*

Title: _____

Witness as to Surety:

_____
*(signature)*

_____
Surety

By: _____
Attorney-in-Fact *(signature)*

_____

_____
Address of Attorney-in-Fact

**END OF SECTION**

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**SECTION 00 42 00**

**STATEMENT OF BIDDER'S QUALIFICATIONS**

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information desired. Attach all additional sheets to this statement. The Bidder must include this Statement of Bidder's Qualification form, completely filled out with the requested information, and any accompanying information with the Bid.

1. Name of Bidder:
   _____

2. Bidder's permanent, main office address and phone number:
   _____

3. When organized:
   _____

4. If a Corporation, where incorporated:
   _____

5. How many years has Bidder been engaged in the contracting business under present firm or trade firm or trade name?
   _____

6. General description of type of work performed by your company:
   _____

7. Have you ever failed to complete any work awarded to you? If so, where and why?
   _____

8. Have you ever defaulted on a contract? If so, where and why?
   _____

9. Complete a "Project Information Form" (i.e., Bidder's standard form that includes the requested information and is notarized) for projects that match the requirements specified in Paragraph 5.07 of Section 00 20 00 – Instructions to Bidders.

10. Document experience in construction work similar in nature to this Project.

11. Background and experience of the principal members of your organization, including officers.

12. Background and experience of the Project Manager that will be assigned to this Project.

13. Background and experience of the Superintendent that will be assigned to this Project.

14. Name of supervisory personnel certified Level 1A – Fundamentals of the Georgia Erosion and Sediment Control training program.

    _____

15. Any history of litigation, arbitration, or other related mediation actions for the proposed Project superintendent or referenced projects?

    _____

16. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the Owner?

    _____

The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

I,_____, certify that I am _____ of the Bidding Firm, and
*(Name)* *(Title)*

that the answers to the foregoing questions and statements contained therein are true and correct.

BIDDER: _____

By: _____

*(Signature)*

Title: _____

Date: _____

Subscribed and sworn to me this _____ day of _____, 20__.

NOTARY PUBLIC: _____

*(Signature)*

Commission Expires: _____

*(Date)*

(SEAL)

**END OF SECTION**

**SECTION 00 42 01**

**STATEMENT OF ELECTRICAL SUBCONTRACTOR'S QUALIFICATIONS**

This form must be used by the Bidder's proposed Electrical Subcontractor. All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Subcontractor may submit any additional information desired. Attach all additional sheets to this statement. The Bidder must include this Statement of Electrical Subcontractor's Qualifications form, completely filled out with the requested information, and any accompanying information within 3 business days of submitting the Bid.

1. Name of Subconsultant:
   _____

2. Company's permanent, main office address and phone number:
   _____

3. Company's relevant regional office address and phone number (if different than above):
   _____

4. When organized:
   _____

5. If a Corporation, where incorporated:
   _____

6. How many years has your company been engaged in business under present firm or trade firm or trade name?
   _____

7. General description of type of work performed by your company:
   _____

8. Has your company ever failed to complete any work awarded to it? If so, where and why?

   _____

9. Has your company ever defaulted on a contract? If so, where and why?
   _____

10. Complete a "Project Information Form" (i.e., Bidder's standard form that includes the requested information and is notarized) for projects that match the requirements specified in Paragraph 5.07 of Section 00 20 00 – Instructions to Bidders.

11. Document experience in construction work similar in nature to this Project.

12. Background and experience of the principal members of your organization, including officers.

13. Background and experience of the Project Manager that will be assigned to this Project.

14. Background and experience of the Electrical Foreman that will be assigned to this Project.

15. Any history of litigation, arbitration, or other related mediation actions for the proposed Project superintendent or referenced projects?

    _____

16. Provide a statement that your company will perform a minimum of 90 percent of the labor-related work on the Electrical subcontract for this Project with its own forces.

17. Provide a statement that your company has not been involved in liquidated damages in the past 5 years or served the Owner or General Contractor with a claim for additional compensation prepared by an attorney or a claims consultant, excluding routine change order requests. If this is not the case, explain.

18. Provide a statement indicating whether your company has or has not been involved in litigation as a plaintiff against a General Contractor, Owner or Engineering Firm in the past 5 years. If this is not the case, explain.

19. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the Owner?

    _____

The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Electrical Subcontractor's Qualifications.

I,_____, certify that I am _____ of the Electrical

*(Name)* *(Title)*

Subcontracting Firm, and that the answers to the foregoing questions and statements contained therein are true and correct.

BIDDER: _____

By: _____

*(Signature)*

Title: _____

Date: _____

Subscribed and sworn to me this _____ day of _____, 20__.

NOTARY PUBLIC: _____

*(Signature)*

Commission Expires: _____

*(Date)*

(SEAL)

**END OF SECTION**

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**SECTION 00 43 00**

**CORPORATE CERTIFICATE**

I,_____, certify that I am the Secretary of the Corporation named as Bidder in the foregoing Bid; that _____, who signed said Bid on behalf of the Contractor was then _____ of said Corporation; that said Bid was duly signed for and on behalf of said Corporation by authority of its Board of Directors, and is within the scope of its corporate powers; that said Corporation is organized under the laws of the State of _____.

This _____ day of _____, 20__.

Corporate Secretary: _____

*(name signed)*

_____

*(name printed or typed)*

(SEAL)

**END OF SECTION**

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**SECTION 00 44 00**

**CONTRACTOR'S LICENSE CERTIFICATION**

Bidder/Contractor's Name: _____

Georgia Utility Contractor's License Number: _____

Expiration Date of License: _____

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

BIDDER: _____

By: _____

*(name signed)*

_____

*(name printed or typed)*

Title: _____

Date: _____

**END OF SECTION**

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## SECTION 00 45 00

## SECURITY AND IMMIGRATION COMPLIANCE ACT CERTIFICATION

Pursuant to the Georgia Security and Immigration Compliance Act of 2006, Contractor understands and agrees that compliance with the requirements of OCGA 13-10-91 and Georgia Department of Labor Rule 300-10-1 et. seq. are conditions of Agreement.

By initialing in the appropriate line below, Contractor certifies that the following employee number category as identified in OCGA 13-10-91 is applicable to Contractor:

1. _____ 500 or more employees
2. _____ 100 or more employees
3. _____ Fewer than 100 employees

Contractor understands and agrees that, in the event Contractor employs or contracts with Subcontractor in connection with this Agreement, Contractor shall:

1. Secure from each Subcontractor an indication of the employee-number category as identified in OCGA 13-10-91; and
2. Secure from each Subcontractor not licensed as an Utility Contractor in the State of Georgia an attestation of Subcontractor's compliance with OCGA 13-10-91 and Georgia Department of Labor Rule 300-10-1-.02 by causing each Subcontractor to execute the attached Subcontractor Affidavit required by Georgia Department of Labor Rule 300-10-1-.08, or a substantially similar subcontractor affidavit. Contractor further understands and agrees that Contractor shall require the executed Subcontractor Affidavit, if applicable, to become a part of the agreement between Contractor and each Subcontractor. Contractor agrees to maintain records of each Subcontractor attestation required hereunder for inspection by Owner.

_____ _____

BY: Authorized Officer or Agent Date

_____

Title of Authorized Officer or Agent if Contractor

_____

Printed Name of Authorized Officer or Agent

_____

Subscribed and Sworn Before Me on this _____ day of _____, 20____

_____

Notary Public

My Commission Expires:_____

Reference is hereby made to other Sections and forms that shall be provided to the Owner:

1. Section 00 45 20 – Subcontractor Affidavit
2. Section 00 45 30 – Sub-Subcontractor Affidavit

**END OF SECTION**

**SECTION 00 45 20**

**SUBCONTRACTOR AFFIDAVIT (UNDER O.C.G.A. § 13-10-91(B)(3))**

By executing this affidavit, the undersigned Subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with (name of Contractor) on behalf of CHEROKEE COUNTY WATER & SEWERAGE AUTHORITY has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned Subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned Subcontractor will contract for the physical performance of services in satisfaction of such contract only with Sub-Subcontractors who present an affidavit to the Subcontractor with the information required by O.C.G.A. § 13-10-91(b). Additionally, the undersigned Subcontractor will forward notice of the receipt of an affidavit from a Sub-Subcontractor to the Contractor within 5 business days of receipt. If the undersigned Subcontractor receives notice of receipt of an affidavit from any Sub-Subcontractor that has contracted with a Sub-Subcontractor, the undersigned Subcontractor shall forward, within 5 business days of receipt, a copy of such notice to the Contractor. Subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

_____

Federal Work Authorization User Identification Number

_____

Date of Authorization

_____

Name of Subcontractor

_____

Name of Project

_____

Name of Public Employer

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

Executed on _____, ___, 20___ 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 _____, 20___.

_____
NOTARY PUBLIC

My Commission Expires:_____

**END OF SECTION**

**SECTION 00 45 30**

**SUB-SUBCONTRACTOR AFFIDAVIT (UNDER O.C.G.A. § 13-10-91(B)(4))**

By executing this affidavit, the undersigned Sub-Subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract for (name of Subcontractor or Sub-Subcontractor with whom such Sub-Subcontractor has privity of contract) and (name of Contractor) on behalf of CHEROKEE COUNTY WATER & SEWERAGE AUTHORITY has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned Sub-Subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned Sub-Subcontractor will contract for the physical performance of services in satisfaction of such contract only with Sub-Subcontractors who present an affidavit to the Sub-Subcontractor with the information required by O.C.G.A. § 13-10-91(b). The undersigned Sub-Subcontractor shall submit, at the time of such contract, this affidavit to (name of Subcontractor or Sub-Subcontractor with whom such Sub-Subcontractor has privity of contract). Additionally, the undersigned Sub-Subcontractor will forward notice of the receipt of any affidavit from a Sub-Subcontractor to (name of Subcontractor or Sub-Subcontractor with whom such Sub-Subcontractor has privity of contract). Sub-Subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

_____

Federal Work Authorization User Identification Number

_____

Date of Authorization

_____

Name of Sub-Subcontractor

_____

Name of Project

_____

Name of Public Employer

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

Executed on _____, ___, 20___ 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 _____, 20___.

_____

NOTARY PUBLIC

My Commission Expires:_____

**SECTION 00 48 00**

**NON-COLLUSION AFFIDAVIT OF BIDDER**

STATE OF GEORGIA COUNTY OF CHEROKEE

_____, being first duly sworn, deposes and says that:

He or she is _____ of

*(Owner, Partner, Officer, Representative or Agent)*

_____, the Bidder that has submitted the attached Bid;

He or she is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

Such Bid is genuine and is not a collusive or sham Bid;

Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this Affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the Cherokee County Water & Sewerage Authority or any person interested in the proposed Contract; and

The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this Affiant.

(Signed) _____

(Title) _____

Subscribed and Sworn before me this _____ day of _____, 20___.

_____ My Commission Expires: _____

(Notary Public) *(signature)*

(SEAL)

**END OF SECTION**

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**SECTION 00 51 00**

**NOTICE OF AWARD**

To: _____ Date: _____, 20__

_____

_____

The Cherokee County Water & Sewerage Authority, herein called Owner, represented by the undersigned has considered the Bid submitted by you for the Work and any adopted alternatives in response to its Invitation to Bid and Instructions to Bidders dated _____ _____, 2025.

Determined to be in Owner's best interest, the Owner accepts your Bid in the amount of _____ _____ DOLLARS ($_____) and intends to execute the Agreement for this Work. You are hereby notified that your Bid has been accepted for the Work. You are required by the Instructions to Bidders to execute the formal Agreement with the undersigned Owner and to furnish the required Contractor's Performance Bond and Payment Bond, proper Insurance Certificate and other required Contract Documents within 15 days from the date of delivery of this Notice to you. **You are required to return an acknowledged copy of this Notice of Intent to Award and all copies of the signed Agreement (leave dates blank) to the Owner for execution.**

As described in the Specifications, the Contract Price includes a lump sum, pre-negotiated costs for sole-sourced equipment, Cash Allowances, and Unit Price Work. Cash Allowances is the amount provided in the Bid for additional Work authorized by the Owner that is outside the original scope of work of this Contract. The Cash Allowance work will be authorized by a Supplemental Work Authorization if this work is required. 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 such item is included in the Contract Price. The Contingency and estimated quantities of items of Cash Allowances and Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. The final Contract Price will be based on determinations of the Supplemental Work Authorizations and actual quantities and classifications of Unit Price Work performed by Contractor to be made by Engineer pursuant to the provisions of the General Conditions, Supplementary Conditions, and the Specifications.

Four copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award. Four sets of the Drawings will be delivered separately or otherwise made available to you immediately.

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

1. Deliver to the Owner four fully executed counterparts of the Contract Documents. Each of the Contract Documents must bear your signature on the Agreement, Payment Bond, Performance Bond, Pre-Construction Oath, Certification of Contractor's Attorney, Contractor and Agreement, and required Subcontractor Affidavit and Agreements.

2. Deliver with the executed Contract Documents the Contract security (Bonds) as specified in the Instructions to Bidders and General Conditions (Paragraph 5.01).

3. Execute the Performance and Payment Bonds, but DO NOT DATE. Cherokee County Water & Sewerage Authority will date the bonds with the same date as the Agreement.

4. Deliver with the executed Contract Documents evidence of all insurance which Contractor is required to provide under the Contract Documents.

5. Deliver with the executed Contract Documents the Insurance Certificate Checklist filled out by Contractor's insurance agent.

If you fail to execute said Agreement and to furnish said bonds and certificates within 15 days from the date of delivery of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Bid as abandoned and as a forfeiture of your Bid Security. The Owner will be entitled to such other rights as may be granted by law and to award the Work covered by your Bid to another, or to re-advertise the Work or otherwise dispose thereof as the Owner may see fit.

Dated this _____ day of _____, 20_____.

**Owner**

_____

By: _____

***ACCEPTANCE OF NOTICE***

Receipt of the above Notice of Award is hereby acknowledged this

_____day of _____, 20_____.

By: _____

Title: _____

**END OF SECTION**

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**SECTION 00 52 00**

**AGREEMENT**

THIS AGREEMENT is by and between the Cherokee County Water & Sewerage Authority (hereinafter called Owner) and _____ (hereinafter called Contractor).

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

## ARTICLE 1 – WORK

1.01 Contractor shall at its own cost and expense furnish all labor, services, tools, materials, equipment, and incidentals necessary to complete all Work as specified or indicated in the Contract Documents to construct the Fitzgerald Creek WPCP Thermal Dryer Facility Project. The Work is generally described in Section 01 11 00 – Summary of Work of the General Requirements.

## ARTICLE 2 – PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described, but not limited to, as follows:

- Construction of new Thermal Dryer Facility
- Construction of new Final Effluent Water Pump Station
- Modifications to existing Solids Electrical Building
- Modifications to existing Compressor Building
- Modifications to existing Dewatering Building No. 1 and No. 2
- Associated site work, including site civil, site piping, stormwater control, and site electrical work
- Associated structural work for new and existing facilities
- Associated electrical and instrumentation and controls for new and existing facilities

## ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Hazen and Sawyer, 1300 Altmore Avenue, Suite 520, Atlanta, GA 30342 (hereinafter called Engineer), which is to act as Owner's representative, assume all duties and responsibilities and have the rights and authority

assigned to Engineer in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

## ARTICLE 4 – CONTRACT TIMES

4.01 Time of the Essence

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

B. *Project Milestone Completion Requirement:* There are no milestones for the Project.

4.02 Days to Achieve Substantial Completion and Final Payment

A. The Work shall be substantially completed within 730 calendar days after the date when the Contract Times commence to run as provided in the General Conditions and completed and ready for final payment in accordance with the General Conditions within 775 calendar days from the date when the Contract Times commence to run.

4.03 Liquidated Damages

A. Owner and Contractor recognize that time is of the essence as stated in Paragraph 4.01 herein and that Owner will suffer financial loss if the Work is not substantially completed within the time specified in Paragraph 4.02.A for Substantial Completion, plus any extensions thereof allowed in accordance with the General Conditions. Owner and Contractor 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 substantially 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) Contractor shall pay Owner one thousand, five hundred dollars ($1,500.00) for each day that expires after the time specified in Paragraph 4.02.A herein for Substantial Completion (adjusted for changes thereof, if any, made in the General Conditions) until the Work is substantially complete.

B. After Substantial Completion, if Contractor shall neglect, refuse or fail to complete the remaining Work within the Contract Time or proper extension thereof, if any, granted by Owner, Contractor shall pay Owner one thousand, five hundred dollars ($1,500.00) for each day that expires after the time specified in Paragraph 4.02.A herein for Work to be completed and ready for final payment (adjusted for extensions thereof, if any, made in accordance with the General Conditions) until the Work is completed and ready for final payment.

4.04 Owner may deduct liquidated damages as determined by the provisions of this Article 4 from progress payments due Contractor under this Agreement.

## ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor, in current funds, for completion of the Work in accordance with the Contract Documents the prices stated in Contractor's Bid, which Bid is attached hereto and identified as Exhibit 1 of this Agreement. As provided in the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer as provided in the General Conditions. Unit prices have been computed as provided in the General Conditions.

## ARTICLE 6 – ARTICLE 6 – PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

A. Contractor shall submit Applications for Payment in accordance with the General Conditions. Applications for Payment will be processed as provided in the General Conditions.

6.02 Progress Payments; Retainage

A. Owner shall make monthly progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer. Contractor's Applications for Payment will be due on the 25th day of each month, or as otherwise mutually agreed by Owner and Contractor, during performance of the Work as provided in Paragraph 6.02.A.1, 6.02.A.2, and 6.02.A.3 herein. All progress payments will be on the basis of the progress of the Work measured by the Schedule of Values provided for in the General Conditions. A progress payment will not be made whenever the value of the Work completed since the last previous progress payment is less than $5,000.

1. All such payments will be measured by values of work completed as provided by the schedule established in Paragraph 2.07 of the General Conditions (and in the case of Unit Price Work based on the number of units completed), plus the value of materials and equipment suitably stored, insured, and protected at the construction site, and with the Owner’s consent, such materials and equipment suitably stored, insured, and protected off-site at a location approved by the Engineer, less a retainage of five percent (5%) of each progress payment requested.

2. The Contractor shall be entitled to withhold retainage from subcontractors in accordance with this Agreement and Georgia Law. At the discretion of the Owner, upon recommendation of the Engineer and with consent of the Contractor, the retainage of each subcontractor may be released separately as the subcontractor completes his work. If the Contractor does not give such consent, the Contractor shall promptly give the Owner a written explanation of its reason.

6.03 Final Payment

A. At Substantial Completion of the Contract Work and as the Engineer determines the Work to be reasonably satisfactory, the Owner shall within 60 days after presentation of Application and other appropriate documentation as required by Article 14 of the General Conditions are provided, pay the retainage to the Contractor. If, at that time, there are any remaining incomplete minor items, an amount equal to 200 percent of the value of each item, as determined by the Engineer, shall be withheld until such item or items are completed. Retainage payments made to the Contractor shall be shared by the Contractor and subcontractors as their interests may appear. The Contractor shall, within 10 days from Contractor's receipt of retainage from the Owner, pass through payments to subcontractors and shall reduce each subcontractor's retainage in the same manner as the Contractor's retainage is reduced by the Owner provided that the work of the subcontractor is proceeding satisfactorily and the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his work including any warranty work as the Contractor in his reasonable discretion may require, including, but not limited to a Payment and Performance Bond.

B. If pursuant to Paragraph 14.04 of the General Conditions, Engineer issues a Certificate of Substantial Completion for a part of the Work prior to the Substantial Completion of all of the Work, the Owner shall within 45 days after presentation of Application and other appropriate documentation as required by Article 14 of the General Conditions are provided, pay the retainage for such part of the Work to the Contractor. If at that time there are any remaining incomplete minor items for such part of the Work, an amount equal to 200 percent of the value of each item, as determined by the Engineer, shall be withheld until such item or items are completed. Retainage payments made to the Contractor shall be shared by the Contractor and subcontractors as their interests may appear. The Contractor shall, within 10 days from Contractor's receipt of retainage from the Owner, pass through payments to subcontractors and shall reduce each subcontractor's retainage for such part of the Work in the same manner as the Contractor's retainage for such part of the Work is reduced by the Owner provided that the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his work including any warranty work as the Contractor in his reasonable discretion may require, including, but not limited to a Payment and Performance Bond.

C. The subcontractor shall, within 10 days from the subcontractor's receipt of retainage from the Contractor, pass through payments to the lower tier subcontractors and shall reduce each lower tier subcontractor's retainage in the same manner as the subcontractor's retainage is reduced by the Contractor, provided that the work of the lower tier subcontractor is proceeding satisfactorily and the lower tier subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his work including any warranty work as the subcontractor in his reasonable discretion may require, including, but not limited to, a Payment and Performance Bond.

D. All prior certificates or estimates upon which payments have been made are approximate only, and subject to correction in the final payment.

6.04 In the event of a conflict, O.C.G.A. Sections 13-10-80 through 13-10-83 shall supersede and control any provisions to the contrary in this Article 6.

6.05 Contractor's Agreements with Subcontractors: The Contractor hereby covenants and agrees with Owner to obtain written agreements from each subcontractor setting forth payment procedures in accordance with the foregoing provisions of this Section. Nothing contained herein shall preclude the Contractor, prior to making payment to a subcontractor, from requiring the payee to submit satisfactory evidence that all payrolls, material bills, and other indebtedness connected with the work have been paid.

**ARTICLE 7 – INTEREST**

7.01 The Current Market Rate will be the rate of interest as stipulated in Paragraph 14.02E of the Supplemental Conditions.

7.02 All moneys not paid by Owner to Contractor when due as provided in Article 14 of the General Conditions shall bear interest at the Current Market Rate. However, no interest shall be paid upon any moneys due by the Owner to the Contractor during the time in which any item is in dispute between the Owner and the Contractor.

7.03 On contracts relating to installation, extension, improvement, maintenance or repair of any water or sewer facility, retainage shall be invested at the Current Market Rate and any interest earned on the retained amount shall be paid to the Contractor when the project has been completed within the Contract Times and for the Contract Price specified in the Contract, or in any amendments or change orders approved in accord with the terms of the Contract.

**ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS**

8.01 As part of the inducement for Owner to enter into this Agreement, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents (including the Addenda listed in Article 9) and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to the Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); if any, that have been identified in Section 01 11 00 – Summary of Work as containing reliable “technical data”, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Section 01 11 00 – Summary of Work as containing reliable “technical data”.

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on:

1. The cost, progress, and performance of the Work;

2. The means, methods, techniques, sequences and procedures of construction to be employed by Contractor, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and

3. Contractor’s safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 8.01.E herein, Contractor does not consider that 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 Documents.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

J. Contractor’s entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

**ARTICLE 9 – CONTRACT DOCUMENTS**

9.01 The Contract Documents consist of the following:

A. This Agreement

B. Advertisement for Bids

C. Instructions to Bidders

D. Bid Form

E. Bid Bond

F. Statement of Bidder's Qualifications

G. Statement of Electrical Subcontractor's Qualifications

H. Corporate Certificate

I. Contractor's License Certification

J. Security and Immigration Compliance Act Certification

K. Subcontractor Affidavit

L. Sub-Subcontractor Affidavit

M. Non-Collusion Affidavit of Bidder

N. Notice of Award

O. Notice to Proceed

P. Pre-Construction Oath

Q. Performance Bond

R. Payment Bond

S. Certification of Contractor's Attorney

T. Certification of Owner's Attorney

U. Certificate of Substantial Completion

V. General Conditions

W. Supplementary Conditions

X. Specifications, as listed in the Table of Contents of the Project Manual, bound separate from this Agreement.

Y. The Drawings bound to the Project Manual, comprising a set entitled “Fitzgerald Creek WPCP Thermal Dryer Facility” and including the following:

1. Cover sheet and sheets listed in the Index of Drawings, bound separate from this Agreement.

Z. Addenda consisting of number 1 through __, inclusive.

AA. The following, which may be delivered or issued on or after the Effective Date of the Agreement, and are not attached hereto:

1. Notice of Award

2. Notice to Proceed

3. Work Change Directive(s)

4. Change Order(s)

5. Field Order(s)

6. Engineer’s written interpretations and clarifications

7. Any other Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Paragraphs 3.04.A and 3.04.B of the General Conditions

9.02 The documents listed in Paragraph 9.01 above are attached to this Agreement (except as expressly noted otherwise above). Documents not attached are incorporated by reference. There are no Contract Documents other than those listed in this Article 9.

9.03 The Contract Documents may only be amended or supplemented as provided in the General Conditions.

**ARTICLE 10 – MISCELLANEOUS**

10.01 Terms

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

10.02 Assignment of Contract

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

10.03 Successors and Assigns

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

10.04 Severability

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

10.05 Waiver

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

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate on the day and year first written above. One counterpart each has been delivered to Owner, Contractor, and Engineer. All portions of the Contract Documents have been signed, initialed, or identified by Owner and Contractor or identified by the Engineer on their behalf.

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

| | |
|---|---|
| Owner: _____ | Contractor: _____ |
| Signature: _____ | Signature: _____ |
| Name: _____ | Name: _____ |
| Title: _____ | Title: _____ |
| (CORPORATE SEAL) | (CORPORATE SEAL) |
| Attest _____ | Attest _____ |
| Title: _____ | Title: _____ |
| Address for giving notices | Address for giving notices |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

Agent for service of process: _____

| | |
|---|---|
| _____ | _____ |
| (Attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement.) | (If Contractor is a corporation, partnership, or limited liability company, attach evidence of authority to sign.) |

| | |
|---|---|
| Designated Representative: | Designated Representative: |
| Name: _____ | Name: _____ |
| Title: _____ | Title: _____ |
| Address: _____ | Address: _____ |
| Phone No.: _____ | Phone No.: _____ |
| Fax No.: _____ | Fax No.: _____ |

**END OF AGREEMENT**

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**SECTION 00 55 00**

**NOTICE TO PROCEED**

To: _____ Date: _____, 20__

_____

_____

You are hereby notified to commence Work in accordance with the Agreement dated _____, 20__ on or before _____, 20__. You are to complete the Work in accordance with the milestone schedule in the Agreement. The milestone work activity durations are as stated in the Agreement. Liquidated damages in the amount scheduled per calendar day for each calendar day the Work remains incomplete after its associated milestone date will be imposed unless the Contract Times are otherwise adjusted for due cause by Change Order to the Agreement.

Before you may start any Work at the Site, Paragraph 2.01.A of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

OWNER

_____

By: _____

Title: _____

***ACCEPTANCE OF NOTICE***

Receipt of the above Notice to Proceed is hereby acknowledged this

_____day of _____, 20___.

By: _____

Title: _____

**END OF SECTION**

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**SECTION 00 55 01**

**PRE-CONSTRUCTION OATH**

**PROJECT NAME:** Fitzgerald Creek WPCP Thermal Dryer Facility

**OWNER PROJECT NUMBER:** _____

**DATE:** _____

STATE OF GEORGIA COUNTY OF CHEROKEE

In accordance with O.C.G.A. § 36-91-21(e), each of the undersigned persons affiliated with

_____.

being first duly sworn, deposes and says that:

I have not directly violated O.C.G.A. § 36-91-21(d), and more specifically, I have not

prevented or attempted to prevent competition in such bidding or proposals by any means whatever,

prevented or endeavored to prevent anyone from making a bid or proposal thereof by any means whatever, nor

caused or induced another to withdraw a bid or proposal for the work.

Each undersigned, to the best of his/her knowledge, affirms that no other officers, agents or other persons acted for or represented the Contractor in the bidding for and procurement of this Contract.

| Signature | Printed Name | Title | Date |
|---|---|---|---|
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |

Subscribed and Sworn to before me this _____ day of _____, 20____.

_____ My Commission Expires: _____

(Notary Public)

(SEAL)

**END OF SECTION**

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**SECTION 00 61 00**

**PERFORMANCE BOND**

**KNOW ALL MEN BY THESE PRESENTS** _____

(hereinafter called the "Principal") and _____

(hereinafter called the "Surety"), are held and firmly bound unto **Cherokee County Water & Sewerage Authority** (hereinafter called the "Owner") and its successors and assigns, in the penal sum of _____, lawful money of the United States of America, for the payment of which the Principal and the Surety bind themselves, their administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,** the Principal has entered, or is about to enter, into a certain written contract with the Owner, dated _____, which is incorporated herein by reference in its entirety (hereinafter called the "Construction Contract"), for the Fitzgerald Creek WPCP Thermal Dryer Facility, more particularly described in the Construction Contract (hereinafter called the "Project"); and

**NOW, THEREFORE,** the conditions of this obligation are as follows, that if the Principal shall fully and completely perform all the undertakings, covenants, terms, conditions, warranties, and guarantees contained in the Construction Contract, including all modifications, amendments, changes, deletions, additions, and alterations thereto that may hereafter be made, then this obligation shall be void; otherwise it shall remain in full force and effect.

Whenever the Principal shall be, and declared by the Owners to be, in default under the Construction Contract, the Surety shall promptly remedy the default as follows:

1) Complete the Construction Contract in accordance with its terms and conditions; or

2) Obtain a bid or bids for completing the Construction Contract in accordance with its terms and conditions, and upon determination by the Surety and the Owners of the lowest responsible qualified bidder, arrange for a contract between such bidder and Owners and make available as the work progresses (even though there should be a default or succession of defaults under the Construction Contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the penal sum set forth in the first paragraph hereof, as may be adjusted, and the Surety shall make available and pay to the Owners the funds required by this Paragraph prior to the payment of the Owners of the balance of the contract price, or any portion thereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by the Owner to the Contractor under the Construction Contract, and any amendments thereto, less the amount paid by the Owner to the Contractor; or, at the option of the Owner;

3) Allow Owner to complete the work and reimburse the Owner for all reasonable costs incurred in completing the work.

In addition to performing as required in the above paragraphs, the Surety shall indemnify and hold harmless the Owner from any and all losses, liability and damages, claims, judgments, liens, costs and fees of every description, which the Owner may incur, sustain or suffer by reason of the failure or default on the part of the Principal in the performance of any or all of the terms, provisions, and requirements of the Construction Contract, including any and all amendments and modifications thereto, or incurred by the Owner in making good any such failure of performance on the part of the Principal.

The Surety shall commence performance of its obligations and undertakings under this Bond promptly and without delay, after written notice from the Owner to the Surety.

The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and any other amendments in or about the Construction Contract, and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions, additions, changes, alterations, extensions of time, change in payment terms, and amendments.

The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment to the Construction Contract, so as to bind the Principal and the Surety to the full and faithful performance of the Construction Contract as so amended or modified, and so as to increase the penal sum to the adjusted contract price of the Construction Contract.

No right of action shall accrue on this Bond to or for the use of any person, entity or corporation other than the Owner and any other obligee named herein, or their executors, administrators, successors or assigns.

This bond is given pursuant to and in accordance with the provisions of O.C.G.A. Section 36-91-1 *et.seq.* and all the provisions of the law referring to this character of Bond as set forth in said Sections or as may be hereinafter enacted, and these are hereby made a part hereof to the same extent as if set out herein in full.

THIS SPACE INTENTIONALLY LEFT BLANK

**IN WITNESS WHEREOF** the undersigned have caused this instrument to be executed and their respective corporate seals to be affixed by their duly authorized representatives this _____ day of _____, 20_____.

_____

Principal

By: _____

Its: _____

_____

Witness

_____

Typed name of witness

_____

Typed address of witness

(Surety)

By: _____

Its: Attorney-in-Fact

_____

Typed name of Attorney-in-Fact

_____

Witness

_____

Type name of witness

_____

Type address of witness

_____

(Address of Surety's Home Office)

Note: Date of Bond must not be prior to date of contract.

**END OF SECTION**

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**SECTION 00 62 00**

**PAYMENT BOND**

**KNOW ALL MEN BY THESE PRESENTS** that_____
(hereinafter called the "Principal") and_____(hereinafter called the "Surety"), are held and firmly bound unto **Cherokee County Water & Sewerage Authority** (hereinafter called the "Owner"), its successors and assigns as obligee, in the penal sum of

_____,
lawful money of the United States of America, for the payment of which the Principal and the Surety bind themselves, their administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,** the Principal has entered, or is about to enter, into a certain written contract with the Owner, dated _____, which is incorporated herein by reference in its entirety (hereinafter called the "Construction Contract"), for the construction of a project known as Fitzgerald Creek WPCP Thermal Dryer Facility as more particularly described in the Construction Contract (hereinafter called the "Project");

**NOW, THEREFORE,** the condition of this obligation is such that if the Principal shall promptly make payment to all persons working on or supplying labor or materials under the Construction Contract, and any amendments thereto, with regard to labor or materials furnished and used in the Project, and with regard to labor or materials furnished, but not so used, then this obligation shall be void; but otherwise it shall remain in full force and effect.

1. A "Claimant" shall be defined herein as any subcontractor, person, party, partnership, corporation or other entity furnishing labor, services or materials used, or reasonably required for use, in the performance of the Construction Contract, without regard to whether such labor, services or materials were sold, leased or rented, and without regard to whether such Claimant is or is not in privity of contract with the Principal or any subcontractor performing work on the Project, including, but not limited to, the following labor, services, or materials: water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Construction Contract.

2. In the event a Claimant files a lien against the property of the Owner, and the Principal fails or refuses to satisfy or remove it promptly, the Surety shall satisfy or remove the lien promptly upon written notice from the Owner, either by bond or as otherwise provided in the Construction Contract.

3. The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and any other amendments in or about the Construction Contract and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason

of any such modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and amendments.

4. The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment or modification to the Construction Contract, so as to bind the Principal and Surety, jointly and severally, to the full payment of any Claimant under the Construction Contract, as amended or modified, provided only that the Surety shall not be liable for more than the penal sum of the Bond, as specified in the first paragraph hereof.

5. This Bond is made for the use and benefit of all persons, firms, and corporations who or which may furnish any materials or perform any labor for or on account of the construction to be performed or supplied under the Construction Contract, and any amendments thereto, and they and each of them may directly sue the Principal and the Surety hereon.

6. No action may be maintained on this Bond after one (1) year from the date the last services, labor, or materials were provided under the Construction Contract by the Claimant prosecuting said action.

7. This bond is given pursuant to and in accordance with the provisions of O.C.G.A. Section 36-91-1 *et.seq.* and all the provisions of the law referring to this character of Bond as set forth in said Sections or as may be hereinafter enacted, and these are hereby made a part hereof to the same extent as if set out herein in full.

THIS SPACE INTENTIONALLY LEFT BLANK

**IN WITNESS WHEREOF,** the Principal and the Surety have hereunto affixed their corporate seals and caused this obligation to be signed by their duly authorized representatives this _____ day of _____, 20 _____.

_____

Principal

By: _____

Its: _____

_____

Witness

_____

Typed name of witness

_____

Typed address of witness

(Surety)

By: _____

Its: Attorney-in-Fact

_____

Typed name of Attorney-in-Fact

_____

Witness

_____

Type name of witness

_____

Type address of witness

_____

(Address of Surety's Home Office)

Note: Date of Bond must not be prior to date of contract.

**END OF SECTION**

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**SECTION 00 62 20**

**CERTIFICATION OF CONTRACTOR'S ATTORNEY**

The undersigned Contractor hereby certifies one of the following:

_____ (initial) Prior to execution and delivery of the contract contained herein, the attorney has examined the attached contract, any applicable performance and payment bonds and the manner of execution thereof, as well as all other documents attached hereto and is of the opinion that upon the execution and delivery of these documents, same will constitute a valid and legally binding obligation of the undersigned contractor in accordance with the terms, conditions and provisions thereof.

_____

Typed Name of Attorney

_____

Signature of Attorney

Date: _____

_____ (initial) The undersigned contractor has an attorney but has not obtained any legal opinion regarding the execution and delivery of these documents.

_____ (initial) The undersigned contractor does not have an attorney and has elected not to engage an attorney regarding the execution and delivery of this contract and attached documents.

**CONTRACTOR**

Name of Contractor: _____

By: _____

Title: _____

Attest: _____

Title: _____

[SEAL]

**END OF SECTION**

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## SECTION 00 62 30

## CERTIFICATION OF OWNER'S ATTORNEY

I, the undersigned _____, the duly authorized and acting legal representative of CHEROKEE COUNTY WATER & SEWERAGE AUTHORITY, do hereby certify as follows:

Prior to execution and delivery thereof by Cherokee County Water & Sewerage Authority, I have examined the attached contract and any applicable performance and payment bonds and the manner of execution thereof, and I am of the opinion that upon the correction of any matters noted hereon, the foregoing contract will be ready for execution and upon execution and delivery will constitute a valid and legally binding obligation of Cherokee County Water & Sewerage Authority in accordance with the terms, conditions, and provisions thereof.

Date: _____

_____

Typed Name

_____

Signature

**END OF SECTION**

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## SECTION 00 65 00

## CERTIFICATE OF SUBSTANTIAL COMPLETION

| | |
|---|---|
| Owner: | Owner's Contract No.: |
| Contractor: | Contractor's Project No.: |
| Engineer: | Engineer's Project No.: |
| Project: | Contract Name: |

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

☐ All Work ☐ The following specified portions of the Work:

**Date of Substantial Completion**

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

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

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 14.04 of the General Conditions.]*

Amendments to Owner's responsibilities: ☐ None
☐ As follows:

Amendments to Contractor's responsibilities: ☐ None
☐ As follows:

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

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

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

**END OF SECTION**

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# SECTION 00 72 00
# GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

**EJCDC C-700, Standard General Conditions**

**of the Construction Contract**

**(2007 Edition)**

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

# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

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CONSTRUCTION SPECIFICATIONS INSTITUTE

**EJCDC C-700 Standard General Conditions of the Construction Contract**
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These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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## ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. 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 which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer 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, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.


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12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.


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27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given 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 under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *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.


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40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *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 for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *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 at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *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, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.


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51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or


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c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

## ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement 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


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Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), 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 Documents;

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.

2.06 *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 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, 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 instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete


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and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

## ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement 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, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of


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the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, 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) any standard, specification, manual, or code, or (c) 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 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

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 Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); 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 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.


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B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. 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.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.


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## ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

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 the Work is to be performed 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.

4.02 *Subsurface and Physical Conditions*

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

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.


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4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition 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 meet any one or more of the categories described in Paragraph 4.03.A; and

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 Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final 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

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and


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contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data;

b. locating all Underground Facilities shown or indicated in the Contract Documents;

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, 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 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the


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consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *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.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.


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C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) 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 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. 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. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.


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H. 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 a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

## ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also


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meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:


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a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

a. Such insurance shall remain in effect for two years after final payment.

b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.


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5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,


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members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:


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1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's


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interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

## ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

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

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.


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B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

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

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 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 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description 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 or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;


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2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

b) 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


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c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified, and

b) available engineering, sales, maintenance, repair, and replacement services; and

4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. 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.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be


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required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner,


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Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.


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6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear 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. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *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.

6.11 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. 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 claim or action, legal or equitable, brought


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by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site 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 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 property to stresses or pressures that will endanger it.

6.12 *Record Documents*

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

6.13 *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. 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, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.


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B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are


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required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

a. Submit number of Samples specified in the Specifications.

b. 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 6.17.D.

B. 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. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and


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d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.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's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any


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disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the


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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 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.


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D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

## ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. 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. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, 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.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:


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1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

## ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

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

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and


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tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *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.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

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 pursuant to Paragraph 6.13.D.

## ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *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 Documents.


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9.02 *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 9.09. 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.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which 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. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.


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9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

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

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.


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D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.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 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

## ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *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 by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).


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B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *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 as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *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.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.


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B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

## ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing


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in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.


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c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone 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 Contractor is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, 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 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.


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3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *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:*

1. Contractor agrees that:

a. 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

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.


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11.03 *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. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

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. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

## ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for 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, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or


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3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.


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12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

## ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and


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testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

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 and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. 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.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.


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B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, 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, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such 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 Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *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, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract


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Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) 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 pursuant to this sentence. If any such acceptance occurs prior to Engineer's


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recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, 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, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, 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 (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) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. 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 13.09.

## ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.


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14.02 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, 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 9.07, 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.


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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 Documents; or

    b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work, or

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

    d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

    d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.


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C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

   a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

   b. 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;

   c. there are other items entitling Owner to a set-off against the amount recommended; or

   d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action 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, when Contractor remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *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 (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.


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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 tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. 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 tentative list.

14.05 *Partial Utilization*

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. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and 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 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.


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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 14.04 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 5.10 regarding property insurance.

14.06 *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 is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *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, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

   d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) 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


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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.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. 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. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees


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specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

## ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *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 notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will 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 established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. 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

3. complete the Work as Owner may deem expedient.


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C. If Owner proceeds as provided in Paragraph 15.02.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 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) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed 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.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. 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. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. 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) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.


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B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 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 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.


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## ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents 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.

17.03 *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 Documents. 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.

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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


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## SECTION 00 73 00

## SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700) (2007 Edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

### ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 A. 19. Add the following at the end of the paragraph: "The Engineer for this Project is Hazen and Sawyer.".

1.01 A. 19. Add the following at the end of the paragraph: "19.1. *Engineer's Consultant*—An individual or entity having a contract with the Engineer to furnish as Engineer's independent professional associate or consultant with respect to the Project. Engineer's Consultant shall mean Engineering Strategies, Inc., Geo-Hydro Engineers, Inc., and TerraMark Land Surveying, Inc.".

1.01 A. 21. Add the following at the end of the paragraph: "The General Requirements are applicable to all Sections of the Specifications and to the entire Work.".

1.01 A. 25. Add the following at the end of the paragraph: "25.1 *Liquidated Damages*—amounts shall be as stipulated in the Agreement. Liquidated Damages shall apply to the Contract Times for the Project. Liquidated Damages shall be both additive and cumulative. Liquidated Damages shall end up on Substantial Completion, and upon final completion of the Work.".

1.01 A. 45. Replace this paragraph with the following: "45. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer and Owner, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents to provide the following: (i) the Owner full time, uninterrupted, continuous operation of the work; and (ii) all required functional, performance, and operational or startup testing has been successfully demonstrated for all components, devices, equipment, and systems to the satisfaction of the Engineer in accordance with the requirements of the Specifications; and (iii) all required inspections and other work necessary for the Engineer to certify "substantially complete" have been completed. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.".

1.01 A. 45. Add the following at the end of the paragraph: "45.1 *Submittals*—All administrative documents, Shop Drawings, Samples, product data, manufacturer's literature, quality control documents, design related documents, record documents, contract

close-out documents, and/or any other specified document prepared or assembled by or for Contractor and submitted by Contractor to the Owner and/or Engineer.”.

1.02 E. Replace subparagraphs 1 through 4 with the following: “1. The words "furnish", "furnish and install", "install", and "provide" or words with similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in place and ready for service.".

After Paragraph 1.02.F, add the following paragraph:

“G. The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract (EJCDC C-700, 2007 Edition) have the meanings assigned to them in the General Conditions.”.

## ARTICLE 2 – PRELIMINARY MATTERS

Add the following paragraph at the beginning of this Article:

“2.00 *Execution of Agreement*

A. At least four counterparts of the Agreement will be executed and delivered by the Contractor to the Owner within fifteen (15) days of the Notice of Award and receipt of Contract Documents by the Contractor for execution; and Owner will execute and deliver one counterpart to Contractor within fifteen (15) days of receipt of the executed Agreement from Contractor.”.

2.01 B. Replace “Before any Work at the Site is started, Contractor and Owner shall each deliver to the other” with “When Contractor delivers the executed counterparts of the Agreement to the Owner, Contractor shall deliver to the Owner”, and replace “and Owner respectively are” with “is”.

2.02 A. Replace paragraph 2.02.A in its entirety with the following:

“A. Owner will furnish to Contractor up to four printed or hard copies of the Contract Documents and one counterpart of the executed Contract Agreement. Additional copies will be furnished upon request at the cost of reproduction and shipping charges.”.

2.02 Add the following paragraphs:

“B. Owner may also, if requested by Contractor, furnish Contractor with electronic copies of the Drawings and other Contract Documents. Contractor agrees it will only use the same for performing the Work and will not disseminate the same except to its subcontractors where necessary to perform the Work. Contractor shall obtain written acceptance of any subcontractor to these limitations before disseminating the same to such subcontractor. Electronic copies of the Contract Documents will be provided as a convenience to the

Contractor. The Owner and Engineer assume no liability and shall be held harmless for any discrepancies between the hard copy and electronic copy of the Contract Documents.

1. To receive electronic copies of the Contract Documents (PDF, TIF, DWG, DWF, etc.), Contractor shall complete and provide to Engineer an Electronic Media Release Form. Contractor shall provide same documentation from any subconsultant, sub-subconsultant or supplier requesting electronic copies of the Contract Documents.".

2.03 Replace paragraph 2.03.A in its entirety with the following:

"A. The Contract Time will commence to run on the date established in the Notice to Proceed; A Notice to Proceed may be given at any time within 60 days after the Effective Date of the Agreement. By mutual consent of the parties to the Contract, these time limits may be changed.".

2.07 A. Change "At least 10 days before submission of the first Application for Payment" to "Within ten days after the pre-construction conference,".

Add the following paragraph:

"2.08 *Licensing*

A. Before any work at the site is started which is governed by the Construction Industry Licensing Board of Georgia (O.C.G.A. Section 43-14-1 et seq and Section 43-41 et seq), or its rules or regulations, Contractor shall inform himself of those rules and regulations, and qualifications for licensure, and if requested shall deliver proof of compliance to the Owner and Engineer.".

## ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING AND REUSE

Following Paragraph 3.01.C, add the following paragraphs:

"D. It is the intent of the Specification and Contract Documents to obtain an operable Project. Equipment, components, systems, etc., therein shall be made operable by the Contractor.

E. The Contract Drawings may be supplemented from time to time with additional Drawings by the Engineer as may be required to illustrate the work or, as the work progresses, with additional Drawings, by the Contractor, subject to the approval of the Engineer. Supplementary Drawings, when issued by the Engineer or by the Contractor, after approval by the Engineer, shall be furnished in sufficient quantity to all those who, in the opinion of the Engineer, are affected by such Drawings.

F. Where the word “similar” occurs in the Contract Document, it shall have a general meaning and not be interpreted as being identical, and all details shall be worked out in relation to their location and their connection with other parts of the Work.

G. Each and every clause or other provision required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be amended to make such insertion.

H. “Imperative” or “Command” type language is used in the Contract Documents. This command language refers to and is directed to the Contractor.

I. Emphasis, such as italics or quotes, has been used throughout the Contract Documents. Use of emphasis shall not change the meaning of the term emphasized.

J. Specifications stated on the Drawings govern that particular part of the Work and have equal weight and importance as the printed Specifications.”.

3.03 B. Add the following paragraphs:

“2. In resolving inconsistencies within the Contract Documents, precedence shall be given in the following descending order:

a. Change Orders.

b. Work Change Directives.

c. Field Orders.

d. Engineer’s written interpretations and clarifications.

e. Notice to Proceed.

f. Addenda.

g. Contract Agreement.

h. Supplementary Conditions.

i. General Conditions.

j. Specifications.

k. Drawings:

i. Figure dimensions on Drawings shall take precedence over scaled dimensions.

ii. Detailed drawings shall take precedence over general drawings.

iii. In case of discrepancy between small-scale detail and large-scale detail, the large-scale detail shall govern. On any of the Drawings where a portion of the Work is drawn out and the remainder is shown in outline, the portion drawn out shall apply also to all other like portions of the Work.

l. Bidding Requirements.

3. In cases where products or quantities are omitted from the Specifications, the description and quantities on the Drawings shall govern.”.

**ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS**

4.02 A. 1. Delete “known to Owner”; after “Site”, add “that have been utilized by the Engineer in preparing the Contract Documents”.

4.02 A. 2. Delete “known to Owner”; after “(except Underground Facilities)”, add “that have been utilized by the Engineer in preparing the Contract Documents”.

4.02 Add the following paragraphs:

“C. In preparation of Drawings and Specifications, Engineer or Related Entities relied upon the reports of explorations and tests of subsurface conditions at the Site that are listed in the following subparagraphs. The Engineer and the Engineer’s Consultants are not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of the Engineer. These reports are not part of the Contract Documents.

1. Revision 1 of Report included herein as Appendix A dated August 26, 2025, prepared by Geo-Hydro Engineers, Inc., entitled “Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Fitzgerald Creek Thermal Dryer Facility, Cherokee County Water & Sewage Authority, Woodstock, Georgia”

D. In preparation of Drawings and Specifications, Engineer or Related Entities relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Site. Copies of the known record drawings

have been made available electronically to all bidding Contractors. No guarantee is made regarding the accuracy of data presented in these drawings. These drawings are not part of the Contract Documents.

1. Drawings dated October 2020, (record set issued January 2025) prepared by Hazen and Sawyer, entitled “Cherokee County Water and Sewerage Authority, Georgia, Fitzgerald Creek WPCP, Expansion to 11.75 MGD”

2. Drawings dated May 2019 (Conformed), prepared by Atkins, entitled “Cherokee County Water & Sewerage Authority, Fitzgerald Creek WRF Dewatering Building Expansion”

3. Drawings dated April 2005, prepared by PBS&J, entitled “Cherokee County Water & Sewerage Authority, Fitzgerald Creek WPCP Expansion to 6 MGD”

4. Drawings dated November 2004 (Conformed date February 2005), prepared by Welker & Associates, Inc., entitled “Cherokee County Water & Sewerage Authority, Fitzgerald Creek WPCP Solids Handling”

    a. Including 7 sheets included herein in Appendix B showing existing Sludge Pump Vault to be demolished/removed

5. Drawings dated July 2003, prepared by Welker & Associates, Inc., entitled “Cherokee County Water & Sewerage Authority, Fitzgerald Creek WPCP Phase I Expansion to 2.0 MGD”

    a. Including 5 sheets included herein in Appendix B showing existing Parshall Flume (3 sheets) and Sludge Thickener Vault (2 sheets) to be demolished/removed

E. Copies of reports and select portions of known existing record drawings are made available via Appendix A and Appendix B, respectively, to the Specifications.”.

4.04 B. Add the following paragraph:

“3. The Owner, Engineer, and Engineer’s Consultants shall not be liable to Contractor for any claims, costs, losses or damages incurred or sustained by Contractor on or in connection with any other project or anticipated project.”.

4.04 Add the following paragraphs:

“C. The dimensions and descriptions given on the Drawings for adjacent work by others, if any, (including any existing facilities or utilities previously

constructed for Owner) are based on the design drawings and not as-built drawings. Prior to commencing the Work, the Contractor shall verify all as-built conditions and information whenever existing facilities or utilities may impact the Work. Failure of Contractor to so verify all as-built conditions prior to commencing the Work shall bar Contractor from later seeking additional compensation for conflicts with existing facilities or utilities.

D. Prior to the construction or installation of any proposed facility or pipeline, the Contractor shall expose all existing utilities true to their vertical and horizontal location, within the vicinity of the Work. In order to avoid conflicts between existing and proposed facilities or utilities, the Contractor shall either relocate the existing or proposed utility on a temporary or permanent basis, or shall take whatever means necessary to protect the existing facilities or utilities during the installation of proposed utilities, as approved by the Engineer. No additional payment will be made for the relocation of existing utilities or for any work associated with the protection of existing facilities or utilities.".

4.05 Add the following paragraphs:

"B. Engineer may check the lines, elevations, and reference marks set by Contractor, and Contractor shall correct any errors disclosed by such check. Such a check shall not be considered as approval of Contractor's work and shall not relieve Contractor of the responsibility for accurate construction of the entire Work.

C. The Contractor shall review the Contract Documents and the Project site to determine the presence and location of any property or rights-of-way monuments or markers, and to assess the possibility of disruption to these monuments or markers. It will be the Contractor's responsibility to flag, erect guard posts, or provide offset references for the protection or the re-monumentation of these property or rights-of-way monuments or markers. In the event these monuments or markers are covered over or disturbed, it will be the Contractor's responsibility to employ a surveyor licensed in the state of Georgia to re-establish those monuments or markers of property or rights-of-way, which were present prior to Work on the Project.

D. It shall be the Contractor's responsibility to verify all reference points shown on the Contract Documents prior to beginning Work on the site. This verification shall be conducted by professionally qualified personnel in a manner which will verify the accuracy of the information shown in the Contract Documents. On projects which involve the connection to, or additions to existing structures, the elevations of these existing structures shall also be verified. Any findings which differ from those shown on the Contract Documents shall be submitted in writing to the Engineer for resolution.

E. Additional surveys necessary for the construction staking shall be performed by the Contractor, the cost of which shall be incorporated into the appropriate items of Work. On projects in which payment is classified

by depth of cut, the construction staking shall be performed in a manner that will allow for the determination of cut classification. During construction of the project, the Contractor shall keep a daily log and record of the location of all underground pipes, all structures, and any deviation from the Drawings. The Contractor shall keep and furnish this daily log and record in a manner which will allow the Engineer to incorporate these items into the Contract Documents.".

4.06 G. Replace paragraph G in its entirety with "G. Not Used.".

**ARTICLE 5 – BONDS AND INSURANCE**

5.01 A. Change "becomes due" to "is made by the Owner".

5.02 A. At the end of the paragraph, change "as may be provided in the Supplementary Conditions" to "as provided below:" and add the following subparagraphs:

"1. Surety shall be in good standing with Georgia's Insurance Commissioner's Office.

2. Surety and Insurers must have an A.M. Best Financial Strength Rating and a Financial Size Category as stated in the insurance requirements specified elsewhere in these Contract Documents.

3. The surety shall have an underwriting limitation in Circular 570 in excess of the Contract Price.".

5.02 Add the following paragraph:

"B. All Sureties and Insurers must have an A.M. Best Financial Strength Rating of A- or higher, with a Financial Size Category of X or higher.".

5.03 B. At the end of the paragraph, add ", if any".

5.03 Add the following paragraphs:

"F. Notwithstanding provisions of O.C.G.A., Section 33-23-44, insurance certificate must include the following affirmative statement: "Coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty (30) days prior written notice has been given to Owner and to each other additional insured to whom a certificate of insurance has been issued."

G. Insurance certificate must show proper name and address of Cherokee County Water & Sewerage Authority: 140 West Main Street, Canton, Georgia 30114, and show Owner, Engineer, and Engineer's Consultants as additional insureds.

H. Insurance certificate must show coverage applies for contractual liability for Contractor's indemnity obligations under Paragraphs 6.07, 6.11 and 6.20 of the General Conditions.

I. In addition to the requirement for the policy limits specified under Paragraphs 5.04, A.3 – A.5, the applicable insurance certificate must show that the entire aggregate policy limits for general liability coverage will apply specifically for the Project.

J. Each insurance certificate for coverage other than Worker's Compensation Insurance must show that a waiver of rights of recovery against any of the insureds or the additional insureds is in effect.

K. Certificate for Contractor's liability insurance must show coverage of claims for damages because of bodily injury, sickness or death of any person or property damage resulting from the ownership, maintenance or use of mobile equipment.

L. Certificate for Worker's Compensation Insurance must show coverage includes executive officers and Contractor's leased employees, temporary staff and part-time employees.

M. Owner may waive specific insurance coverages set forth in Paragraph 5.04 where Contractor provides equivalent insurance coverage by way of a different combination of policies.

N. Each insurance certificate must show coverage is underwritten with an insurance carrier which has A.M. Best ratings as stipulated in Paragraph 5.02 B.

O. An authorized representative of the insurance company(ies) shall certify that all of the required insurance coverages and amounts specified hereinafter are provided by the submitted policies. The certification shall be signed by the authorized representatives of the insurance company(ies) and notarized. The authorized representative of the insurance company(ies) shall specifically indicate with the submittal which of the policies submitted fulfills which specific coverage and amounts specified under Article 5.04 of the Supplementary Conditions. The certification statement and correlation shall be furnished and included with the insurance certificates.

P. One (1) copy of each such insurance policy and certificates indicating each type of coverage mentioned, and the correlation between the insurance furnished and that required, shall be filed with each of the Insured.".

5.04 Add the following paragraphs:

"C. The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage specified below or greater where required by Laws and Regulations.

1. The limits of liability for the insurance required by paragraph 5.04 shall provide the following coverages for not less than the following limits or greater where required by Laws and Regulations:

a. For coverage as required by paragraphs 5.04 A.1 and 5.04 A.2 (Worker's Compensation):

| | |
|---|---|
| (1) State | Statutory Limit |
| (2) Federal | Statutory Limit |
| (3) Employer's Liability | $ 1,000,000 |

b. For coverage as required by paragraphs 5.04 A.3, 5.04 A.4 and 5.04 A.5 (General Liability) which shall also include broad form property damage liability, loss of use of tangible property, and loss of use of property that has not been damaged but has been rendered useless nonetheless, completed operations and product liability coverage's and eliminate the exclusion with respect to property under the care, custody and control of Contractor other than Contractor's work or equipment:

| | |
|---|---|
| (1) Aggregate | $ 2,000,000 |
| (2) Each Occurrence | $ 2,000,000 |
| (3) Products and completed operations, aggregate | $ 2,000,000 |
| (4) Personal and advertising injury | $ 2,000,000 |
| (5) Fire Damage/Legal Liability | $ 100,000 |
| (6) Medical Expense Limit any one person | $ 5,000 |

(7) Property damage liability insurance will provide explosion, collapse, and underground coverages where applicable.

| | |
|---|---|
| (8) Excess/Umbrella Liability: | |
| General Aggregate | $ 5,000,000 |
| Each Occurrence | $ 5,000,000 |

c. The aggregate policy limits for general liability coverage must be designated to the Project. The excess/umbrella policy must provide additional coverage for policy limits in excess of the general liability (including products and completed operations), automobile liability, contractual liability and employer's liability. Mobile equipment coverage described in paragraph 5.03 G must be included.

d. For coverage as required by paragraph 5.04 A.6 (Automobile Liability):

(1) Combined Single Limit (Bodily Injury and Property Damage): $ 1,000,000

(2) Coverage must be provided for all owned/leased, hired and non-owned vehicles.

e. The Contractual Liability coverage required by paragraph 5.04 B.3 of the General Conditions shall provide coverage for not less than the following amounts:

| | |
|---|---|
| (1) General Aggregate | $ 2,000,000 |
| (2) Each Occurrence (Bodily Injury and Property Damage) | $ 2,000,000 |

f. The aggregate policy limits for Contractual Liability must be designated to the Project. As indicated in paragraphs 5.04 A.3-A.5, the excess/umbrella policy must provide additional coverage in excess of these amounts.

D. Any renewal of a policy shall have an original retroactive date no later than the date of the Contract.

E. Contractor's Pollution Liability (CPL) – coverage shall be provided with minimum limits of $5,000,000 per occurrence or claims made and aggregate with Engineer and Owner named as additional insureds. This insurance shall be primary and non-contributory as to Engineer and Owner. A waiver of subrogation in favor of Engineer and Owner shall be provided.

Contractor's Pollution Liability Coverage for Lead and Asbestos Not Excluded – coverage for lead and asbestos exposure through remediation shall be provided by the Contractor's Pollution Liability Policy with minimum limits of $5,000,000 per occurrence or claims made and aggregate with Engineer and Owner named as additional insureds. This insurance shall be primary and non-contributory coverage as to Engineer and Owner. A waiver of subrogation in favor of Engineer and Owner shall be provided.

F. Additional Insureds: The Owner, Engineer, and Engineer's Consultants shall be covered as Additional Insured under any and all Insurance required by this Contract, and such insurance shall be primary with respect to the Additional Named Insured. Confirmation of this shall appear on the Accord Certificate of Insurance, and on any and all applicable Insurance policies. However, this requirement does not apply to Workers' Compensation or Professional Liability Insurance. Copies of endorsements showing that the Owner and each additional insured identified herein have been added to the policies as an additional insured shall be attached to each of the certificates.".

5.06 Delete Paragraph 5.06 in its entirety and insert the following in its place:

"5.06 *Property Insurance*

A. Contractor shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof except for flood perils which shall have a $1,000,000 limit (subject to such deductible amounts as may be provided in these Supplemental Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants and any other person or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk or Installation Floater "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework and Work in transit and shall insure real and personal property against at least the following perils: fire, lightning, extended coverage, theft, vandalism and malicious mischief, explosives and blasting, wind, flood, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair of replacement of any insured property (including but not limited to fees and charges of engineers and architects, permits, loss and damage to the Work, temporary building and scaffoldings, false work, work in transit, and materials and supplies, fixtures, machinery and equipment);

4. cover materials and equipment in transit for incorporation in the Work or stored at the site or at any other location prior to being incorporated in the Work, provided that such materials and equipment have been recommended by Engineer; and be maintained in effect until final agreed to in writing by Owner, Contractor, and Engineer with thirty days written notice to each

other additional insured to whom a certificate of insurance has been issued;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup;

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued; and

8. contain the following provisions: (1) coverage for property in transit and (2) coverage for building damage as required by ordinance and law including demolition, debris removal and increased cost of construction.

B. Property insurance furnished under this contract shall have deductibles no greater than $25,000 for all perils.

C. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions or approved by Owner. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

D. The policies of insurance required to be purchased and maintained by Contractor in accordance with paragraph 5.06 shall comply with the requirements of paragraph 5.04 B.5.".

5.07 A. Replace paragraph A with the following:

"A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 by Contractor will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Contractor as trustee or otherwise payable under any policy so issued.".

5.07 B. Delete paragraph B in its entirety.

5.07 C. Delete paragraph C in its entirety.

5.08 A. Delete “as fiduciary”.

5.08 B. Delete “as fiduciary” (in 3 locations) and delete “and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties”.

5.09 A. Replace paragraph A with the following:

“A. If Owner has any objection to the coverage afforded by or other provision of the insurance required to be purchased and maintained by Contractor in accordance with this Article 5 on the basis of its not complying with the Contract Documents, Owner will notify Contractor in writing thereof within ten days of the date of delivery of such certificate to Owner in accordance with Paragraph 2.01. Contractor shall provide such additional information in respect of insurance provided by Contractor as Owner may reasonably request.”.

5.10 A. Delete “finds it necessary” and replace with “chooses”.

**ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES**

6.01 A. Change “Contractor shall supervise, inspect, and direct…” to “Contractor shall supervise, provide quality control, inspect and direct…”.

6.01 B. After the first sentence, add “Contractor shall also designate, in writing, a representative, hereinafter referred to as Project Manager, assigned to the Project on a full-time basis during execution of the Work who shall have the authority to act on behalf of Contractor, including executing the orders or directions of the Engineer without delay. This Superintendent and/or Project Manager shall have full authority to promptly supply products, tools, plant equipment, and labor as may be required to diligently prosecute the Work. All communications given to or received from the Superintendent and/or the Project Manager shall be binding on Contractor.”.

6.01 Add the following paragraphs:

“C. If at any time during the Project the Superintendent or Project Manager leaves the Project site while Work is in progress, Engineer shall be notified and provided with the name of Contractor’s representative having responsible charge.

D. Contractor shall also designate the person responsible for Contractor’s quality control while Work is in progress. Engineer shall be notified in writing prior to any change in quality control representative assignment.

E. Prior to the Commencement of the Contract Times, Contractor shall furnish to the Owner and Engineer the names, resumes, 24-hour contact information and other relevant information associated with the Project Manager and the Superintendent that are to be assigned to this project. The Project Manager and Superintendent must be acceptable to the Owner and Engineer.".

6.02 A. Insert "skilled," after "competent" and add "Contractor shall, upon demand from the Engineer, immediately remove any manager, superintendent, foreman or workman whom the Engineer or Owner may consider incompetent or undesirable." after the first sentence.

6.02 Add the following paragraphs:

"C. Regular working hours shall be Monday through Friday, excluding holidays, occurring between the hours of 7:00 AM and 5:00 PM, unless restricted otherwise, and shall comply with any applicable ordinances in effect. Contractor shall establish a 40-hour work week with regular scheduled work times consisting of five 8-hour days, within the hours and days allowed above unless otherwise approved by the Owner. 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.

C. Contractor shall pay all extra costs incurred by the Owner associated with work, outside of regular working hours, including additional support services, inspection services, testing services, utilities or other applicable costs. The cost associated with the Owner's inspection overtime will be the amount as provided below, depending upon individuals assigned to the Project, the type of work being inspected, and the date of the invoice; i.e., allowing for salary escalation. Contractor will not be responsible for extra costs associated with inspection overtime for work in excess of 40 hours per week when such overtime work is explicitly required by the Contract Documents.

1. The rate of $150.00/hour/person will apply for the overtime work performed on behalf of the Owner.

D. Except in the case of emergencies or other unusual circumstances, no work shall be permitted on the project on Sunday.

E. The Engineer will determine to what extent extraordinary onsite personnel work is required during Contractor's overtime work or working hours outside regular scheduled work hours.".

6.03 A. In the last line after the word "performance", add ", quality control".

6.03 B. After the first sentence, add: “All products (material and equipment) provided on this Project shall be new and unused and provided by the Contractor unless specified otherwise, shall be products currently manufactured by the manufacturer, i.e., products shall not be discontinued or out-of-date products nor shall they be of the last production run of the product. Contractor shall incorporate the previous sentence in any contract or agreement between Contractor and subcontractor or supplier supplying products provided on this Project.”.

6.03 B. Change “Specifications” to “Contract Documents”.

6.03 Add the following paragraph:

“D. Without limiting the responsibility or liability of the Contractor pursuant to this agreement, all warranties given by manufacturers on materials or equipment incorporated in the work are hereby assigned by the Contractor to the Owner. Such assignment shall be effective upon completion of Contractor’s warranty period. If requested, the Contractor shall execute formal assignments of said manufacturer’s warranties to the Owner. All such warranties shall be directly enforceable by the Owner. Such assignment shall in no way affect the Contractor’s responsibilities and duties during the warranty period.”.

6.06 A. After the first sentence, add: "Acceptance of any Subcontractor, other person or organization by Owner shall not constitute a waiver of any right of Owner to reject defective Work.” At the end of this paragraph, add “If more than twenty-five percent of the work (as measured by dollar value and not including specialty work that is customarily subcontracted) is to be performed by one or more subcontractors, then Contractor is obligated to notify Owner in writing of this intent with the submission of the Bid and to provide such supplemental information within three days of the bid as outlined under Article 17 of Instructions to Bidders.”

6.06 B. First sentence, delete: "If the Supplementary Conditions", and substitute "The Instructions to Bidders". The fourth line, delete: "Supplementary Conditions", and substitute "Instructions to Bidders". Delete “, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued.”.

6.06 G. Delete 6.06.G in its entirety and substitute the following:

“6.06 G. All work performed for Contractor by a Subcontractor shall be pursuant to an appropriate agreement between the Contractor and Subcontractor. The Subcontractor shall not commence work until the Contractor has obtained all insurance as required by Paragraphs 5.02 through 5.03 inclusive.”

6.06 Add the following paragraphs:

“H. Owner or Engineer may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, information about

amounts paid on their behalf to Contractor in accordance with Contractor's Applications for Payment.

I. Specialty Subcontractors: Contractor shall utilize the services of Specialty Subcontractors on those parts of the Work which is declared as specialty work in Specifications and which, under normal contracting practices, is best performed by Specialty Subcontractors, as required by the Engineer in Engineer's sole discretion, at no additional cost to the Owner. If Contractor desires to self-perform specialty work, Contractor shall submit a request to the Owner, accompanied by evidence that Contractor's own organization has successfully performed the type of work in question, is presently competent to perform the type of work, and the performance of the work by Specialty Subcontractors will result in materially increased costs or inordinate delays.

J. The Contractor shall perform a minimum of 50 percent of the onsite labor with its own employees.".

6.08 A. Third sentence of paragraph delete, "or if there are no Bids...to the Work.", and substitute "and the Contractor shall pay all charges of utility owners for connections to the Work.".

6.09 B. Delete paragraph in its entirety and substitute the following:

"B. If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, he shall give Engineer prompt written notice thereof. If Contractor performs any Work knowing it to be contrary to such Laws or Regulations, and without such notice to Engineer, he shall bear all costs arising therefrom. The Contractor shall, at all times, observe and comply with and shall cause all his agents and employees and all his Subcontractors to observe and comply with all such existing Laws or Regulations, and shall protect and indemnify the Owner and the Engineer and the municipalities in which work is being performed, and their officers and agents against any claim, civil penalty, fine or liability arising from or based on the violation of any such Law or Regulation, whether by himself or his employees or any of his Subcontractors.".

6.09 Add the following paragraphs:

"D. The Contractor shall keep fully informed of all laws, ordinances and regulations of the federal, state, county, city and municipal governments or authorities in any manner affecting those engaged or employed in the Work or the materials used in the Work or in any way affecting the conduct of the Work and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same.

1. Security and Immigration Act: Contractor and its Subcontractors who are not licensed Utility Contractors in the State of Georgia shall register and comply with O.C.G.A. § 13-10-90 et. seq. and Georgia Department of Labor Chapter 300-10-1.

E. Contractor shall perform those duties as they relate to O.C.G.A. Section 36-91-92, including filing the Notice of Commencement. Contractor shall provide Owner and Engineer with proof of having performed these duties before any progress payments or final payment shall be considered due and payable to the Contractor.

F. Where professional engineering and/or architectural services are required in connection with any of the components required by the Contract, all Bidders and component suppliers must make certain that there is full compliance with all applicable laws of the State of Georgia and any other state governing professional engineering and/or architecture. The Owner and Engineer do not warrant that any entity listed as an acceptable manufacturer is or will be in compliance with such laws.

G. Any fines levied against the Owner for failure of Contractor to properly maintain required NPDES erosion and sediment control measures or any other related requirements will be deducted as set-offs from payments due Contractor.”.

6.13 A. Add “pollution of or” prior to the word “damage”.

6.13 B. First sentence, after "Contractor" add the following:

", subject to provisions 6.09.B,"

6.13 C. Delete the second sentence.

6.13 Add the following paragraphs:

“G. The property, improvements or facilities at the Site shall be replaced or restored to a condition as good as when Contractor entered upon the Site. In case of failure on the part of Contractor to restore such property, or make good such damages or injury, the Owner may, after 48 hours written notice, or sooner in the case of an emergency, proceed to repair, rebuild, or otherwise restore such property, improvements or facilities as may be deemed necessary. The cost thereof will be deducted from any monies due or which may become due Contractor under this Contract.

H. Contractor’s Plan for Safety Precautions and Programs

1. Before any Work at the site is started, Contractor shall have prepared Contractor’s written plan for Project-specific safety precautions and programs, complete with respect to procedures and actions that the Contractor intends Contractor and all others as provided in paragraphs 6.13 A.1 and 13.02 A, to follow in order for Contractor and all others to comply with all applicable Laws and Regulations. Contractor’s plan for safety precautions and programs shall have been approved and endorsed by Contractor’s designated safety representative required in paragraph 6.14 A.

2. Contractor shall revise Contractor's plan for safety precautions and programs at appropriate times to reflect changes in construction conditions, the Work, Contractor's means, methods, techniques, sequences and procedures of construction, and the requirements of paragraph 13.02 A. Contractor shall disseminate the original plan and revisions to all others indicated in paragraphs 6.13 A and 13.02 A.

3. Contractor's plan for safety precautions and programs will not require more stringent safety requirements, training or other qualifications for all others, including those specified in paragraph 13.02 A and their employees, than Contractor sets forth for comparable activity and responsibility of Contractor, Subcontractors, and Suppliers and their respective employees.

4. Contractor must provide their corporate and site specific protocols for conducting operations during the COVID-19 pandemic.".

I. Work During Pandemic

1. Contractor shall adhere to all local, state, and national orders as well as follow all Centers for Disease Control guidance for essential operations, including, but not limited to, wearing masks, wearing gloves, temperature checks, and maintaining social distancing of a minimum of six feet until all such orders are no longer in effect. Immediately communicate to Engineer and Owner any known or suspected cases of COVID-19.

6.17 A. 1. a. Change "General Requirements" to "Specifications".

6.17 A. 1. b. Change "will" to "shall".

6.17 Add the following paragraphs:

"F. Excessive Submittal Resubmission: Engineer will record time required by Engineer for excessive submittal review occasioned by Contractor's resubmission, in excess of two resubmissions of any required submittal, caused by unverified, unchecked or unreviewed, incomplete, inaccurate or erroneous, or nonconforming submittals. Upon receipt of Engineer's accounting time and costs, Contractor will reimburse Owner for the charges of Engineer's review for excessive resubmissions through set-offs from the recommended Owner payments to Contractor as established in Paragraph 14.02 of the General Conditions.

G. In the event that the Contractor provided a submittal for a previously approved item, whether such is as a substitution or in addition to the previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time as may be required to perform all reviews of the substitute item, unless the change is specifically requested by the Owner.".

6.19 A. After the first sentence, add the following:

"All materials or equipment delivered to the site shall be accompanied by certificates, signed by an authorized officer of the supplier, and notarized guaranteeing that the materials or equipment conform to specification requirements. Such certificates shall be immediately turned over to the Engineer. Materials or equipment delivered to the site without such certificates will be subject to rejection.".

6.20 A. First sentence, after "…claims, costs" add the following:

", civil penalties, fines,"

6.20 A. After the word “liable”, add “, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity. If through the negligent act or omission on the part of Contractor, any other contractor or any subcontractor shall suffer loss or damage on the Work, Contractor shall settle with such other Contractor or Subcontractor by agreement or arbitration if such other Contractor or Subcontractor will so settle. If such other Contractor or Subcontractor shall assert any claim against Owner and/or Engineer on account of any damage alleged to have been sustained, Owner shall notify Contractor, who shall indemnify and save harmless Owner and Engineer against any such claims.”.

6.20 C. 1. Add “negligent” before “preparation”.

6.20 C. 2. Add “negligently” at the beginning of the sentence.

6.20 C. Add the following subparagraph:

“3. Nothing in the Contract Documents shall create or give to third parties any claim or right of action against the Contractor, the Owner or the Engineer beyond such as may legally exist irrespective of the Contract.”.

6.20 Add the following paragraph:

“D. Contractor, Subcontractors, Suppliers and others on the Project, or their sureties, shall maintain no direct action against the Engineer, their officers, employees, affiliated corporations, consultants, and subcontractors, for any claim arising out of, in connection with, or resulting from the engineering services performed. Only the Owner will be the beneficiary of any undertaking by the Engineer.”.

**ARTICLE 7 – OTHER WORK AT THE SITE**

7.02 A. In the first sentence, delete “intends to” and delete “Project at the”.

7.02 B. After the word “coordination”, add “with other contractors”.

7.02 Add the following paragraph:

"C. If Owner contracts with others for the performance of other work on the Site, the Contractor shall attend and participate in coordination meetings with the other on-site contractors.".

7.03 B. Delete "Owner and".

7.03 C. Delete "Owner and".

Add the following paragraphs:

"7.04 *Claims Between Contractors*

A. Should Contractor cause damage to the work or property of any separate contractor at the Site, or should any claim arising out of Contractor's performance of the work at the Site be made by any separate contractor against Contractor, Owner, Engineer, or any other person, Contractor shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by mediation, arbitration, or at law.

B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold Owner, Engineer, and the officers, directors, employees, agents, and other consultants of each and any of them harmless 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 directly, indirectly or consequentially out of or resulting from any action, legal or equitable, brought by any separate contractor against Owner, Engineer, or the officers, directors, employees, agents, and other consultants of each and any of them to the extent based on a claim arising out of Contractor's performance of the Work. Should a separate contractor cause damage to the Work or property of Contractor or should the performance of work by any separate contractor at the Site give rise to any other claim, Contractor shall not institute any action, legal or equitable, against Owner, Engineer, or the officers, directors, employees, agents, and other consultants of each and any of them or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any mediator or arbitrator which seeks to impose liability on or to recover damages from Owner, Engineer, or the officers, directors, employees, agents, or other consultants of each and any of them on account of any such damage or claim.

C. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of a separate contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable hereto, Contractor may make a claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner, and/or Engineer and

the officers, directors, employees, agents, or other consultants of each and any of them for any delay, disruption, interference or hindrance caused by any separate contractor. This Paragraph does not prevent recovery from Owner and Engineer for activities that are their respective responsibilities.”.

**ARTICLE 8 – OWNER'S RESPONSIBILITIES**

8.02 A. Delete in its entirety.

8.06 A. Delete in its entirety.

8.11 A. Delete in its entirety.

**ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION**

9.01 A. Delete in its entirety and substitute the following:

“A. Engineer will be the Owner’s representative during the construction period, and his instructions shall be carried into effect promptly and efficiently.”.

9.02 A. Delete in its entirety.

9.03 B. The Resident Project Representative will serve as the Engineer's liaison with the Contractor, working principally through the Contractor's resident superintendent to assist him in understanding the intent of the Contract Documents.

9.03 C. The Resident Project Representative shall conduct on-site observations of the work in progress to confirm that the work is proceeding in accordance with the Contract Documents. He will verify that tests, equipment and systems start-ups and operating and maintenance instructions are conducted as required by the Contract Documents. He will have the authority to disapprove or reject defective work in accordance with Article 13.

9.09 Add the following paragraphs:

“F. Except upon written instructions of the Engineer, the Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.

2. Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Shall not undertake any of the responsibilities of Contractor, Subcontractors or Contractor's superintendent, or expedite the Work.

4. Shall not advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract.

5. Shall not advise on or issue directions as to safety precautions and programs in connection with the Work.".

**ARTICLE 10 – CHANGES IN WORK; CLAIMS**

10.01 A. Add the following subparagraphs:

"1. Owner may, in anticipation of possibly ordering an addition, deletion or revision to the Work, request Contractor to prepare a proposal of cost and times to perform Owner's contemplated changes in the Work. Contractor's written proposal shall be transmitted to the Engineer promptly, but not later than fourteen days after Contractor's receipt of Owner's written request and shall remain a firm offer for a period not less than sixty days after receipt by Engineer.

2. Contractor is not authorized to proceed on an Owner-contemplated change in the Work prior to Contractor's receipt of a Change Order (or Work Change Directive) incorporating such change into the Work.

3. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a claim for an adjustment in Contract Price or Contract Times (or Milestones).

4. The Owner shall not be liable to the Contractor for any costs associated with the preparation of proposal associated with the Owner's contemplated changes in the Work.".

10.03 Add the following paragraphs:

"B. In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The stipulated compensation (Contract Price or Contract Time, or both) set forth in the Change Order includes payment for:

a. the Cost of the Work covered by the Change Order,

b. Contractor's fee for overhead and profit,

c. interruption of Progress Schedules,

d. delay and impact, including cumulative impact, on other work under the Contract Documents, and

e. extended home office and jobsite overhead;

2. the Change Order constitutes full mutual accord and satisfaction for the change to the Work;

3. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and

1. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.”.

10.05 B. In the first sentence, change “30 days” to “14 days”. In the second sentence, add “written” before “supporting data” and change “60 days” to “21 days (and monthly thereafter for continuing events)”.

10.05 E. Delete “,unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial”.

## ARTICLE 11 – COST OF THE WORK; CASH ALLOWANCES, UNIT PRICE WORK

11.01 A. 1. Last sentence, following “…in Paragraph 11.01.B,” insert the following:

“or claims for extra cost based on an escalation of labor costs throughout the period the Contract,”

11.01 A. 2. Add the following at the end of the paragraph:

“No claims for extra cost shall be considered based on an escalation of material costs throughout the period of the Contract.”.

11.01 A. 3. Delete second sentence "If required ... be acceptable."

11.01 A. 4. Delete in its entirety.

11.01 A. 5. a. Delete in its entirety.

11.01 A. 5. c. Add the following before last sentence of paragraph:

"These rates shall include all fuel, lubricants, insurance, etc. Equipment rental charges shall not exceed the prorated monthly rental rates listed in the current edition of the 'Compilation' of Rental Rates for Construction Equipment" as published by the Associated Equipment Distributors. Charges per hour shall be determined by dividing the monthly rates by 176.".

11.01 A. 5. f. Delete in its entirety.

11.01 A. 5. g. Delete in its entirety.

11.01 A. 5. h. Delete in its entirety.

11.02 B. 1. Add the following subparagraphs:

"c. Contractor agrees that Owner-directed work will be accomplished by increasing the resources on the Project as necessary so as not to impact the Project Schedule. Time extensions will not be given for Owner-directed work unless the new work can be shown to directly impact the critical path of the Project.

d. Contractor overhead and profit cost for Owner-Directed Work will be calculated according to Section 00 72 00, Standard General Conditions of the Construction Contract, paragraph 12.01 C., and will be paid from the Cash Allowance for Owner-Directed Work.

11.02 C. Change the title of this paragraph to "*Allowances for Owner-Directed Work*".

11.02 C. 1. Change "a contingency allowance" to "an allowance for Owner-Directed Work".

## ARTICLE 12 – CHANGE OF CONTRACT PRICE OF CONTRACT TIMES

12.01 C. 2. b. Add "based on subcontractor's actual Cost of the Work" at the end of the paragraph.

12.01 C. 2. c. Add "except the maximum total allowable cost to the Owner shall be the Cost of the Work plus a maximum collective aggregate fee for Contractor and all tiered Subcontractors of 26.8 percent" to the end of the paragraph.

12.03 A. Add "quarantine restrictions, strikes, freight embargoes, acts of war (declared or not declared)," before "acts of God".

12.03 B. Delete in its entirety and substitute the following:

"B. Delays beyond the control of the Contractor, as provided in paragraph 12.03 A., shall not entitle the Contractor to obtain additional project overhead costs unless such delays extend the Project as described below:

1. beyond the original Contract Times,

2. beyond the Contract Times for which the overhead costs have been previously approved, or

3. beyond Contract Times that are extended as a result of delays described in 12.03 C.

For the purpose of this paragraph, overhead costs shall be the supplemental costs defined in 11.01 A. 5., paragraphs a., b., c., g., h., and i. The Contractor's bid shall

include all overhead costs as necessary to be on the Project for the original Contract Times.”.

12.03 C. Add the following after the last sentence:

“Delays described in this Paragraph 12.03 C. shall be determined as follows:

1. Contractor shall obtain weather history for the most recent five (5) years (minimum) preceding the Bid date. Weather history shall be obtained from the National Oceanic & Atmospheric Administration (NOAA) or other source approved by the Engineer. Historical weather shall be based on data from the weather reporting station closest to the project site.

2. For delays associated with an abnormal amount of rain, the Contractor shall use the weather history to calculate an average number of days that rainfall exceeded 0.1-inches for the period (month, quarter, year, etc.) in question. The average value calculated shall be rounded up to the next full day. The Contractor will be awarded a time extension equal to the number of days, above the calculated average, that the period in question experienced rainfall in excess of 0.1 inches. A Contract Time extension will not be awarded for rain amounts less than 0.1 inches.

3. For daily rain amounts in excess of 1-inch, the Contractor shall be awarded one day beyond the number of days calculated as described above. The added day shall be a recovery period for the Contractor to perform site maintenance, to dewater the site and to restore erosion control facilities before resuming work.

4. For delays associated with other abnormal weather events, the weather history shall be used to calculate an average number of days for the type of weather considered to be the cause of a delay. (Calculation of the average number of days shall be as described above.) The Contractor will be awarded a time extension equal to the number of days beyond the calculated average for the period in question. Where the Contractor can demonstrate that the abnormal weather event has impaired his ability to perform work, beyond the day of the abnormal event, a recovery day, or days, to perform site maintenance as necessary to restore the site to a workable condition may be awarded. The recovery days may be awarded if requested in writing by the Contractor and approved by the Engineer. Written requests for recovery days shall include a description of work activities performed during the recovery days.

## ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.03 A. At the beginning of the paragraph, add “Contractor is responsible for the initial and subsequent inspections of Contractor’s Work to ensure that the Work conforms to the requirements of the Contract Documents.” and at the end of the paragraph, add “Contractor shall establish an inspection program and a testing plan acceptable to the Engineer and shall maintain complete inspection and testing records available to Engineer.”.

13.03 B. Add “non-Contractor” after “…perform all”.

13.03 C. Delete paragraph in its entirety and substitute the following:

“C. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be specifically inspected, tested, or approved by some public body, Contractor shall assume full responsibility therefore, pay all costs in connection therewith and furnish Engineer the required certificates of inspection, testing or approval.”.

13.03 Add the following paragraphs:

“G. The Owner reserves the right to independently perform at its own expense, laboratory tests on random samples of material or performance tests on equipment delivered to the site. These tests if made will be conducted in accordance with the appropriate referenced standards or Specification requirements. The entire shipment represented by a given sample, samples or piece of equipment may be rejected on the basis of the failure of samples or pieces of equipment to meet specified test requirements. All rejected materials or equipment shall be removed from the site, whether stored or installed in the Work, and the required replacement shall be made, all at no additional cost to the Owner .

H. Tests required by Contract Documents to be performed by Contractor and that require test certificates to be submitted to Owner or Engineer for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or certification is not required testing laboratories or agencies shall meet the following applicable requirements:

1. “Recommended Requirements for Independent Laboratory Qualification”, published by the American Council of Independent Laboratories.

2. Basic requirements of ASTM E329, “Standard of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction” as applicable.

3. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.”.

13.05.A First sentence, after “...conform to the Contract Documents”, insert "or if the Work interferes with the operation of the existing facility".

13.05 Add the following paragraph:

“B. If Owner stops Work under Paragraph 13.05 A., Contractor shall not be entitled to an extension of Contract Times or increase in Contract Price.”.

13.06 Add the following paragraph:

“C. At any time during the progress of the Work and up to the date of final acceptance, the Engineer shall have the right to reject any work which does not conform to the requirements of the Contract Documents, even though such work has been previously inspected and paid for. Any omissions or failure on the part of the Engineer to disapprove or reject any Work or materials at the time of inspection shall not be construed as an acceptance of any defective work or materials.”.

13.07 Add the following paragraph:

“F. Repetitive malfunction of an equipment or product item shall be cause for replacement and an extension of the correction period to a date one year following acceptable replacement. A repetitive malfunction shall be defined as the third failure of an equipment or product item following original acceptance.”.

## ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Add the following paragraphs:

“B. The Contractor shall submit for the Engineer's approval, a complete breakdown of all Lump Sum Items in the Proposal. This breakdown, modified as directed by the Engineer, will be used as a basis for preparing estimates and establishing progress payments.

C. A Lump Sum Payment equal to 1-1/2% of the total Bid Price (to include all bonds, insurance, move-on expenses, etc.) will be allowed for 'mobilization' as a progress payment line item. The actual cost of bonds and insurance (up to the maximum payment of 1-1/2%) will be considered in the initial payment request provided that cost documentation suitable to the Engineer is furnished by the Contractor. Any outstanding balance of the mobilization line item will be payable when the Project work is 10% complete as indicated by the approved progress payments (less cost of mobilization and stored equipment).”.

14.02 A. 3. Delete subparagraph in its entirety and replace with the following:

"3. Progress payment request shall include the percentage of the total amount of the Contract which has been completed from the start-up of the Project to and including the last day of the preceding month, or other mutually agreed upon day of the month accompanied by such data and supporting evidence as Owner or Engineer may require.".

14.02 A. Add the following subparagraphs:

"4. Forms to be used shall be prepared by the Contractor and submitted to the Engineer for approval.

5. At the option of the Owner, partial payment up to the estimated value, less retainage, may be allowed for any materials and equipment not incorporated in the Work, pursuant to the following conditions:

a. Major equipment items stored off site shall be stored in a bonded warehouse and properly maintained during storage.

b. Equipment or materials stored on the site shall be properly stored, protected and maintained.

c. For any partial payment the Contractor shall submit, with his monthly progress payment from each material or equipment manufacturer, bills or invoices indicating actual material cost.

d. Contractor shall submit evidence that he has paid for materials or equipment stored and for which the Engineer has authorized partial payment and previous progress payments, prior to submission of the next monthly payment request.

6. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.".

14.02 B. 1. First sentence, replace "10 days" with "30 days".

14.02 D. Add the following subparagraphs:

"4. Items entitling Owner to retain set-offs from the amount recommended, include, but are not limited to:

a. Owner compensation to Engineer at an estimated average rate as specified herein per each extra personnel hour for labor plus expenses because of the following Contractor-caused events:

(1) Delays necessitating a time extension for the performance of Engineer's services.

(2) Witnessing retesting of corrected or replaced defective Work.

(3) Return visits to manufacturing facilities to witness factory testing or retesting.

(4) Submittal reviews in excess of three reviews by Engineer for substantially the same Submittal.

(5) Evaluation of proposed substitutes and in making changes to Contract Documents occasioned thereby.

(6) Hours worked by Contractor in excess of normal work hours as defined by Paragraph 6.02 of the General Conditions, necessitating Engineer to work overtime.

(7) Return visits to the Project by Engineer for Commissioning Activities not performed on the initial visit.

b. Fines levied against the Owner for Contractor's performance of NPDES Erosion and Sedimentation Control Measures or other permit violations.

c. The cost of repair, rebuilding or restoration of property improvements or facilities by the Owner as outlined in Paragraph 6.13.

d. Liability for liquidated damages incurred by Contractor as set forth in the Agreement.

5. The rates of $100.00 to $240.00 per hour, depending on person performing the service, will apply for the additional services performed by the Engineer on behalf of the Owner.".

14.02 Add the following paragraphs:

"E. *Prompt Payment Clause*

1. Owner and Contractor agree that all partial payments and final payments shall be subject to the Georgia Prompt Pay Act, as originally enacted and amended, and as set forth in O.C.G.A. § 13-11-1 through § 13-11-11, except as provided below to the extent authorized by law.

2. Interest Rate: For purposes of computing interest on late payments, the rate of interest shall be the applicable monthly interest rate for the Georgia Fund 1 investment pool managed by the Georgia Office of Treasury and Fiscal Services.

3. Payment Periods:

   a. When Contractor has performed in accordance with the provisions of these Contract Documents, the Owner shall pay Contractor within 45 days of receipt by the Owner or the Owner's representative of any properly completed Application for Payment, based upon work completed or service provided pursuant to the terms of these Contract Documents.

   b. When a subcontractor has performed in accordance with the provisions of its subcontract and the subcontract conditions precedent to payment have been satisfied, Contractor shall pay to that subcontractor and each subcontractor shall pay to its subcontractor, within ten days of receipt by Contractor or subcontractor of each periodic or final payment, the full amount received for such subcontractors work and materials based on work completed or service provided under the subcontract, less retainage expressed as a percentage, but such retainage shall not exceed that retainage being held by the Owner, provided that the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete its work as contractor in its reasonable discretion may require, including but not limited to a payment and performance bond.

4. Interest on Late Payment: Except otherwise provided in these Contract Documents and/or in O.C.G.A. § 13-11-5, if a periodic or final payment to Contractor is delayed by more than the time allotted in Paragraph 14.02 E. 3.b., or if a periodic or final payment to a subcontractor is delayed more than ten days after receipt of periodic or final payment by Contractor or Subcontractor, the Owner, Contractor, or subcontractor, as the case may be, shall pay interest to its Contractor, or subcontractor beginning on the day following the due dates as provided in Paragraph 14.02 E. 3.b., at the rate of interest as provided herein. Interest shall be computed per month or a pro-rata fraction thereof on the unpaid balance. There shall be no compounded interest. No interest is due unless the person or entity being charged interest received "Notice" as provided in Paragraph 14.02 E. 5. Acceptance or progress payments or final payment shall release all claims for interest on said payments.

5. Notice of Late Payment and Request of Interest: Any person or entity asserting entitlement to interest on any periodic or final payment pursuant to the provisions of this Prompt Payment Clause shall provide "notice" to the person or entity being charged interest of the charging party's claim to interest on late payment. "Notice" shall be in writing, served by U.S. Certified Mail – Return Receipt

Requested at the time the properly completed Application for Payment is received by the Owner or Owner's representative, and shall set forth the following:

a. A short and concise statement that interest is due pursuant to the provisions of the Georgia Prompt Pay Act and this Prompt Payment Clause;

b. The principal amount of the periodic or final payment which is allegedly due to the charging party; and

c. The first day and date upon which the charging party alleges that said interest will begin to accrue, pursuant to the provisions of the Georgia Prompt Pay Act and this Prompt Payment Clause.

6. These "Notice" provisions are of the essence; therefor, failure to comply with any requirement as set forth in the Prompt Payment Clause precludes the right to interest on any alleged late payment to which said "Notice" would otherwise apply.

7. Integration with the Georgia Prompt Pay Act: Unless otherwise provided in these Contract Documents, the parties hereto agree that these provisions of this Prompt Payment Clause supersede and control all provisions of the Georgia Prompt Pay Act (O.C.G.A. § 13-11-1 through § 13-11-11 (1994)), as originally enacted and as amended, and that any dispute arising between the parties hereto as to whether or not the provisions of this contract or the Georgia Prompt Pay Act control will be resolved in favor of these Contract Documents and its terms.".

14.03 Add the following paragraphs:

"B. No materials or supplies for the Work shall be purchased by Contractor or subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. Contractor warrants that Contractor has good title to all materials and supplies used by Contractor in the Work, free from all liens, claims or encumbrances.

C. Contractor shall indemnify and save Owner harmless from all claims growing out of the lawful demands for payment by subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. Contractor shall, at Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then Owner may, after having served written notice on the said Contractor either pay unpaid bills, of which Owner has written notice, direct, or withhold from Contractor's unpaid

compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to Contractor shall be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon Owner to either Contractor or to Contractor's Surety. In paying any unpaid bills of Contractor, Owner shall be deemed the agent of Contractor and any payment so made by Owner shall be considered as payment made under the Contract by Owner to Contractor and Owner shall not be liable to Contractor for any such payment made in good faith.".

14.04 Delete paragraph in its entirety and substitute the following:

"A. Contractor shall, in writing to Owner and Engineer, certify that the entire Project is substantially complete and request that Engineer issue a certificate of Substantial Completion. Specific items of Work that must be completed prior to the Engineer's issuance of a certificate of Substantial Completion include, but are not limited to, the following:

1. All portions of the Project shall be installed and operational, including accessories integral to the operation of the equipment, such as seal water stations, high and low level/pressure shutdown switches, and other operational, control, and safety devices.

2. All functional testing, startup, checkout, and field performance testing, including specified equipment run-in times, shall be completed, and all manual and automatic controls shall be in place and operating as intended.

3. All final painting, coatings, paving, grading, and other finish items shall have been completed, and manufacturers' field test reports, O&M Manuals, warranties, record drawings, training and all other submittals shall have been submitted and approved.

4. The Plant Control System improvements shall have been completed.

5. All work deemed deficient by any state, local, or other regulatory agency or department shall have been corrected and all occupancy permits required by local building officials shall have been obtained.

6. Correction of all deficient Work items listed by all state, local, and other regulatory agencies or departments.

7. All submittals must be received and approved by the Engineer, including but not necessarily limited to, the following:

a. Record documents.

b. Factory test reports, where required.

c. Equipment and structure test reports.

d. Manufacturer's Certificate of Proper Installation.

e. Operating and maintenance information, instructions, manuals, documents, drawings, diagrams, and records.

f. Spare parts lists.

8. All additional warranty or insurance coverage requirements have been provided.

9. All manufacturer/vendor-provided operator training is complete and documented.

10. All occupancy permits required by local building code officials have been obtained.

11. Other items of Work specified elsewhere as being prerequisite for Substantial Completion.

The Contractor's notification shall include an itemized list of remaining incomplete work.

B. Within a reasonable time thereafter, Owner, Contractor and Engineer shall make an inspection of the Project to determine the status of completion.

C. If Engineer and Owner do not consider the Project substantially complete, Engineer will notify Contractor in writing giving his reasons therefor. If Engineer and Owner consider the Project substantially complete, Engineer will prepare and deliver to Owner a tentative certificate of Substantial Completion and the responsibilities between Owner and Contractor for maintenance, heat and utilities. There shall be attached to the certificate a tentative list of items to be completed or corrected before Substantial Completion, and the certificate shall fix the time within which such items shall be completed or corrected, said time to be within Contract Time.

D. After the date of Substantial Completion, the Owner shall have the right to exclude the Contractor from the Project site during such periods when construction activities might interfere with the operation of the treatment plant facility. The Owner, however, shall allow the Contractor reasonable access either to remove the Contractor's property or for completion or correction of incomplete Punch List items.".

14.05 Delete paragraph in its entirety and substitute the following:

"A. Portions of the Project will be utilized by the Owner to maintain continuous operation of the treatment plant prior to substantial completion of the project. The parts of the work anticipated to be utilized include the following:

1. Digesters.

2. Digester Blowers.

3. Solids Electrical Building.

4. Dewatering Building 2.

B. Owner may also request partial utilization of other parts of the Project which he believes he may use without significant interference with construction of the other parts of the Project.

C. When the facilities are ready to be turned over to the Owner, the Contractor shall certify to the Owner and Engineer that said part of the Project is substantially complete and request the Engineer to issue a certificate of Substantial Completion for that part of the project. Contractor, Engineer, and Owner will then follow the procedures listed in Paragraph 14.04 herein for that part of the work.

1. Within a reasonable time thereafter, Owner, Contractor and Engineer shall make an inspection of that part of the Project to determine its status of completion. If Engineer and Owner do not consider that it is substantially complete, Engineer will notify Contractor in writing giving his reasons therefor. If Engineer and Owner do consider that part of the Project to be substantially complete, Engineer will execute and deliver to Owner and Contractor a certificate to that effect, fixing the date of Substantial Completion as to that part of the Project, attaching thereto a tentative list of items to be completed or corrected before Substantial Completion of the entire Project and fixing the responsibility between Owner and Contractor for maintenance, heat, and utilities as to that part of the Project. Owner shall have the right to exclude Contractor from any part of the Project which Engineer has so certified to be substantially complete, but Owner shall allow Contractor reasonable access to complete items on the tentative list.

2. "Substantial Completion" of these items means that the individual facilities are completed to the point that the facilities can be used for their intended purpose and will perform their designed function adequately as part of the wastewater treatment process, to the satisfaction of the Engineer and Owner and as defined in Paragraph 14.04 A. herein.

3. The Contractor's guarantee period and start date for associated warranties shall be the date that the portion of the Work is declared substantially complete.

4. Release of retainage will not be applied to substantial completion of components to be utilized by the Owner prior to the completion of the Project; retainage release will only be applied upon substantial completion of the entire Project in accordance with the General Conditions.".

14.07 A. 1. Add the following at the end of the paragraph: "Under no circumstances will Contractor's application for final payment be accepted by the Engineer until all Work required by the Contract Documents has been completed.".

14.07 A. 2. Change the period to a semicolon at the end of paragraph d and add the following subparagraphs:

"e. The Contractor's signed and sealed final change order to close the Contract;

f. Close-out documentation from the issuing agency for all permits obtained by the Contractor for the Project; and

g. Any other data reasonably required by the Owner and/or Engineer, including execution of Affidavit of Contractor, establishing payment or satisfaction of all obligations, including releases, waivers of liens, and documents of satisfaction of debts.".

14.07 B. 1. Delete ", within ten days after receipt of the final Application for Payment,". Add the following to the end of the paragraph: "If the Application for Payment and accompanying documentation are appropriate as to form and substance, Owner will in accordance with the applicable State or local General Law, pay Contractor the amount recommended by Engineer.".

14.07 C. 1. Change "Thirty" to "Forty-Five".

**14.09** A. **2**. Delete "other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled"**.**

## ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 Add the following paragraph:

"B. Should the Owner suspend Work due to repeated unsafe Work conducted by the Contractor which is confirmed by subsequent inspection by OSHA, the Contractor shall not be allowed any adjustment in Contract Price or extension of Contract Time attributed to this delay.

15.02 A. 2. Add the following to the end of first sentence after "jurisdiction": "(including those governing employee safety)"

15.02 A. Change the period to a semicolon at the end of subparagraph 4 and add the following subparagraphs:

"5. If Contractor abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of Owner, or if the Contract or any claim thereunder shall be assigned by Contractor otherwise than as herein specified;

6. Contractor is adjudged bankrupt or insolvent;

7. Contractor makes a general assignment for the benefit of creditors;

8. A trustee or receiver is appointed for Contractor or for any of Contractor's property;

9. Contractor files a petition to take advantage of any debtor's relief act, or to reorganize under the bankruptcy or applicable laws;

10. Contractor repeatedly fails to supply sufficient skilled workmen, materials or equipment;

11. Contractor fails to make satisfactory progress toward timely completion of the work; or

12. Contractor repeatedly fails to make prompt payments to subcontractors or material suppliers for labor, materials or equipment.".

15.02 B. Add the following at the end of the paragraph: "unless Contractor otherwise cures the deficiency in accordance with Paragraph 15.02 D.".

15.02 Add the following paragraph:

"G. Any termination by Owner pursuant to Paragraph 15.02 may result in the disqualification of Contractor for bidding on future contracts of Owner.".

15.03 A. After "terminate" add the following: "or discontinue, in whole or in part,".

15.04 A. Change "30 days" to "45 days" in two locations.

15.04 B. Change "30 days" to "45 days" in two locations.

Add the following:

"15.05 *Assignment of Contract*

A. Contractor shall not assign, transfer, convey or otherwise dispose of the Contract, or of his legal right, title, or interest in or to the same or to any part thereof, without the prior written consent of the Owner. Contractor shall not assign by power of attorney or otherwise any monies due him and payable under this Contract without the prior written consent of the Owner. Such consent, if given, will in no way relieve the Contractor from any of the obligations of this Contract. Owner shall not be bound to abide by or observe the requirements of any such assignment.".

## ARTICLE 16 – DISPUTE RESOLUTION

16.01 Delete paragraphs A, B, and C in their entirety and replace with the following:

"A. If required by applicable laws and regulations, and not specifically excluded elsewhere, either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding."

## ARTICLE 17 – MISCELLANEOUS

17.01 Add the following paragraphs:

"B. No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this Contract. Any notice to the Contractor, from Owner and Engineer, relative to any part of this Contract shall be in writing.

C. Electronic mail and messages will not be recognized as a written notice.

D. If the Contractor does not notify the Owner in writing within 24 hours of the belief that a field order, additional work by other contractors or the Owner, or subsurface, latent, or unusual unknown conditions entitles the Contractor to a Change Order, no consideration for time or money will be given the Contractor.".

17.05 A. Replace paragraph in its entirety with the following:

"A. Each and every provision of this Agreement shall be construed in accordance with and governed by Georgia law. The parties acknowledge that this Contract is executed in Cherokee County, Georgia and that the Contract is to be performed in Cherokee County, Georgia. Each party hereby consents to the Cherokee County Superior Court's sole jurisdiction over any dispute which arises as a result of the execution or performance of this Agreement, and each party hereby waives any and all objections to venue in the Cherokee County Superior Court.".

Add the following Article and amend the Table of Contents:

**"ARTICLE 18 – LIQUIDATED DAMAGES FOR FAILURE TO COMPLETE WORK ON TIME**

18.01 *Liquidated Damages*

A. If the Contractor shall fail to complete the Work within the Contract Time, or extension of time granted by the Owner in accordance with Article 12, then the Contractor will pay to the Owner the amount for liquidated damages as specified in the Contract for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Documents.

B. The Contractor shall not be charged with liquidated damages or any excess cost when delay in completion of the Work is due to the following and the Contractor has promptly given written notice of such delay to the Owner or Engineer:

C. To any preference, priority or allocation order duly issued by the Owner.

D. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes; and abnormal and unforeseeable weather; and

E. To any delays of Subcontractors occasioned by any of the causes specified in Paragraphs 18.01 C. and 18.01 D. of this Article.".

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

**** * * PUT ON CONTRACTOR'S LETTERHEAD * * ****

**DATE:** _____

**TO:** OWNER: _____

ADDRESS: _____

_____

_____

**RE:** Project
Title
Contract No.

We hereby certify that the labor and materials listed on this request for payment have been used in the construction of this work, or that all materials included in this request for payment and not yet incorporated into the construction are now on the site or stored at an approved location with proper insurance to protect these stored materials; and that all lawful charges for labor, materials, etc., covered by previous Certificates of Payment have been paid and that all other lawful charges on which this request for payment is based have been paid for in full or will be paid for in full from the funds received in payment of this request within ten (10) calendar days from receipt of this partial payment from the Owner.

CONTRACTOR: _____
BY: _____
TIME: _____

State of _____
County of _____

Sworn to and subscribed before me this _____ day of _____ 20 _____ .

_____
Notary Public (Seal)

My Commission expires _____

**END OF SECTION**

**SECTION 01 11 00**

**SUMMARY OF WORK**

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Summary
2. Location and Description of Work
3. Construction Contracts, This Project
4. Construction Contracts, Other Projects
5. Work by Others
6. Work by Owner
7. Owner Furnished Equipment and Materials
8. Owner Assigned Procurement Contracts
9. Owner Pre-selected Equipment and Materials
10. Sequence and Progress of Work
11. Contractor's Use of Site
12. Easements and Rights-of-Way
13. Notices to Owners and Authorities of Properties Adjacent to the Work
14. Salvage of Equipment and Materials
15. Partial Utilization by Owner

### 1.02 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the following Site:

1. Fitzgerald Creek Water Pollution Control Plant (WPCP): 260 Colemans Bluff Drive, Woodstock, GA 30188

11-18-20

B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described as follows and all appurtenances related to the Work. The Work shall be as follows:

1. Construction of new Thermal Dryer Facility

2. Construction of new Final Effluent Water Pump Station

3. Modifications to existing Solids Electrical Building

4. Modifications to existing Compressor Building

5. Modifications to existing Dewatering Building No. 1 and No. 2

6. Associated site work, including site civil, site piping, stormwater control, and site electrical work

7. Associated structural work for new and existing facilities

8. Associated electrical and instrumentation and controls for new and existing facilities

## 1.03 CONSTRUCTION CONTRACTS, THIS PROJECT

A. The Contracts under which the Project will be constructed are:

1. Work specified in Division 01 – General Requirements through Division 46 – Water and Wastewater Equipment (inclusive) and Appendices of the Specifications

2. Work shown on Drawings 00-G-001 through 99-I-001 (inclusive) (170 sheets total) of the Drawings

## 1.04 CONSTRUCTION CONTRACTS, OTHER PROJECTS (NOT USED)

## 1.05 WORK BY OTHERS

A. Atlanta Gas Light (AGL), who is the natural gas (NG) supplier/provider for the Project site, will be performing work associated with the Project to provide an adequate supply of NG for the dryer equipment. There is currently an existing 2-inch-diameter NG main along Colemans Bluff Drive that stops at the WPCP's entrance. AGL's scope of work will include upgrading ~1,351 linear feet (LF) of that existing main to 4-inch-diameter and installing ~1,200 LF of new 4-inch-diameter pipeline on the WPCP property to the location of the Thermal Dryer Facility building. AGL anticipates that it will take approximately 2 weeks to perform all of this upgrade work. The Contractor shall be responsible for coordinating with AGL to facilitate this work, including scheduling their work activities to not conflict with AGL's work while it is in progress, to ensure it is

complete prior to startup of the indirect thermal sludge drying system. The Contractor shall be responsible for providing formal notification to AGL 6 months before the time the NG supply is needed to be in service for the Thermal Dryer Facility building.

## 1.06 WORK BY OWNER

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

B. Owner will drain and empty tanks out when requested and turn over to Contractor.

## 1.07 OWNER-PROVIDED EQUIPMENT, MATERIALS, AND SERVICES

A. The Owner will provide System Programmer services for the Instrumentation and Control System through a monthly support agreement with Control Automation, Inc. (Jim Besselman) and/or Prime Controls that is separate from this construction Contract. This applies to all System Programmer services required for this Project. The Contractor shall not provide any System Programmer services as part of their scope of Work. Note that the scope of work for the instrumentation and control system subcontractor is included in the Contractor's scope of Work and is separate from the scope of work for the System Programmer as described in Division 40 – Process Interconnections. The System Programmer is responsible for all plant SCADA system programming and integration and all communications from the indirect thermal sludge drying system System Supplier's main control panel to the plant SCADA system and from the Final Effluent Water Pump Station to the plant SCADA system.

1. All programming from the indirect thermal sludge drying system to the System Supplier's main control panel is the responsibility of the System Supplier.

## 1.08 OWNER ASSIGNED PROCUREMENT DOCUMENTS (NOT USED)

## 1.09 OWNER PRE-SELECTED EQUIPMENT AND MATERIALS

A. Items of equipment and material to be provided by Contractor that have been pre-selected and with Bid Form price listed:

1. Indirect Thermal Sludge Drying System

B. Contractor shall provide equipment and material in accordance with the Contract Documents.

## 1.10 SEQUENCE AND PROGRESS OF WORK

A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of plant operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 00 – Coordination with Owner's Operations.

## 1.11 CONTRACTOR'S USE OF SITE

A. Contractor's use of the Site shall be confined to the areas shown. Contractor shall share use of the Site with other contractors and others specified in this Section.

B. Contractor shall move stored products that interfere with operations of Owner, other contractors, or others performing work for Owner.

## 1.12 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations to within Owner's property, public rights-of-way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and products to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

## 1.13 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

A. Notify owners of adjacent property and utilities when execution of the Work may affect their property, facilities, or use of property.

B. When it is necessary to temporarily obstruct access to property, or when utility service connection will be interrupted, provide notices sufficiently in advance to enable affected persons to provide for their needs. Conform notices to Laws and Regulations and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused.

C. Notify utility owners and other concerned entities at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or exposed utilities.

## 1.14 SALVAGE OF EQUIPMENT AND MATERIALS

A. Existing equipment and materials removed and not shown or specified to be reused in the Work will be Contractor's property, except the following items that shall remain Owner's property:

1. Existing progressive cavity pump and sump pump removed from Sludge Pump Vault to northwest of dewatering buildings as shown on Drawing 01-C-102

2. Existing progressive cavity pump removed from Sludge Thickener Vault to northwest of dewatering buildings as shown on Drawing 01-C-102

After removal of each existing progressive cavity pump and sump pump, Contractor shall notify the Owner, and the Owner shall be allowed 30 calendar days to detach/disconnect any parts or components desired to be retained from the removed pump(s). After the 30-day period has passed or the Owner has notified the Contractor in writing, whichever occurs first, the Contractor shall dispose of the remaining portions of the previously removed pumps that the Owner did not elect to detach/disconnect and retain. The Owner may also elect to retain the pump(s) in their entirety, in which case the Contractor does not need to dispose of anything.

B. Existing equipment and material removed by Contractor shall not be reused in the Work, except where specified or indicated.

C. Carefully remove in manner to prevent damage all equipment and materials specified or indicated to be salvaged and reused or to remain property of Owner. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.

D. Contractor may furnish and install new items, with Engineer's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.

## 1.15 PARTIAL UTILIZATION BY OWNER

A. Owner reserves the right to enter and use portions of the Work prior to Certificate of Substantial Completion is issued by Engineer.

B. Owner will be responsible for preventing premature connections by private and public parties, persons or groups of persons, before Engineer issues Certificate of Substantial Completion for the portion of Work being partially utilized by Owner.

C. Contractor shall cooperate with Owner, Owner's agents, and Engineer to accelerate completion of Work designed for partial utilization by Owner in accordance with Contractor's progress schedule.

D. See Paragraph 14.05 requirements specified in Section 00 73 00 – Supplementary Conditions.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01 14 00**

**COORDINATION WITH OWNER'S OPERATIONS**

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Requirements for coordinating with Owner's operations during the Work and included 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 labor, materials, tools, equipment and incidentals shown, specified and required to coordinate with Owner's operations during the Work.

B. General Requirements

1. Except for shutdowns specified in this Section, perform the Work such that Owner's facility remains 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, or cause odors or other nuisances. Unless otherwise agreed upon, all plant shutdowns shall be limited to Monday through Thursday.

2. Work not specifically covered in this Section or in referenced Sections may, in general, be completed at any time during regular working hours in accordance with the General Conditions and Supplementary Conditions, subject to the requirements in this Section.

3. Contractor has the option of 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.

4. Coordinate shutdowns with Owner and Engineer. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

5. Do not shut off or disconnect existing operating systems, unless accepted by Engineer in writing. Operation of existing equipment will be by Owner unless

otherwise specified or indicated. 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. 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.

C. Continuous Treatment Provision

1. Federal regulations prohibit bypassing of untreated or partially treated wastewater or sewage during construction Work.

2. Contractor shall provide labor, equipment, materials, and incidentals to provide continuous treatment to the level prior to construction Work.

3. Contractor shall be responsible for providing temporary pumping facilities, systems, piping, valve, appurtenances, equipment, materials, and temporary utilities necessary to complete the Work without treatment bypassing.

D. Related Sections

1. Section 01 11 00 – Summary of Work

2. Section 01 25 00 – Substitution Procedures

3. Section 01 73 00 – Demolition and Execution of Work

## 1.02 REFERENCES

A. Definitions: A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.

## 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Review installation procedures under other Specification sections and coordinate Work that must be performed with or before the Work specified in this Section.

2. Notify other contractors in advance of Work requiring coordination with Owner's operations, to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.

3. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

B. Pre-Shutdown Meetings: Contractor shall schedule and conduct meeting with Owner and Engineer after acceptance of Shutdown Planning Submittal and a minimum of 7 days prior to scheduling shutdown.

C. Sequencing

1. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, with Engineer's acceptance. Stages specified in this Section are sequential in performance of the Work.

D. Scheduling

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. 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 conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

5. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

6. Temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems may be required. Coordinate requirements for such shutdowns with Engineer and Owner.

## 1.04 SUBMITTALS

A. Action/Informational Submittals

1. Substitute Sequence Submittal: When deviation from specified sequence is proposed, provide submittal explaining in detail the proposed sequence change

and its effects, including evidence that Owner's operations will not be adversely affected by proposed change. List benefits of proposed sequence change, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00 – Substitution Procedures.

2. Shutdown Planning Submittal

   a. For each shutdown, submit an inventory of labor and materials required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.

   b. Furnish submittal to Engineer at least 30 calendar days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning submittal, completion of Pre-Shutdown Meeting, providing Shutdown Notification and written acceptance by the Engineer and Owner.

3. Shutdown Notification: After acceptance of shutdown planning submittal, completion of Pre-Shutdown Meeting and prior to starting the shutdown, provide written notification to Owner and Engineer of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each shutdown.

## 1.05 SITE CONDITIONS

A. General Constraints: Specified in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits that are to be taken out of service temporarily for the Work. New equipment, materials, 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.

B. The following constraints apply to coordination with Owner's operations:

1. Operational Access: Owner's personnel shall have access to equipment and areas that remain in operation.

2. 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.

3. Dead End Valves or Pipe: Provide blind flanges, watertight bulkheads, or valves at temporary and permanent terminuses of pipes and conduits. 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

pipe or conduit, also provide on downstream side of valve a blind flange with drain/flushing connection.

4. Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid that accumulates in work areas.

5. Draining and Cleaning of Conduits, Tanks, and Basins: Unless otherwise specified, Owner will dewater and drain process tanks and basins at beginning of each shutdown. Cleaning conducted by Contractor shall be as specified as follows:

    a. After the Owner has stopped active influent flow to the Ultraviolet Disinfection facility and has operated existing slide gates in UV channels to prevent flow from entering the common effluent channel to the greatest extent practical, the Contractor shall be responsible for removing all remaining liquid and solids (residuals, debris, etc.) from the common effluent channel at the Ultraviolet Disinfection facility.

    b. Contractor shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by Engineer. Contents of pipes, tanks, basins, and conduits undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, piping, pumps, or other means provided by Contractor. Discharge of fluids across floors is not allowed.

    c. If drainage point is not available on the piping or conduit to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of pipe's or conduit's contents 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 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 vactor truck, acceptable to Engineer.

6. Electrical, Control, Communication, and Monitoring Systems

    a. Owner's existing SCADA system and fiber optic network shall remain functional, subject to the constraints herein.

    b. Fiber optic communications and network connectivity to the Operations Building shall remain operational at all times.

c. Unless Contractor elects to use existing fiber and/or temporary fiber, at his/her discretion, at least one communication path through the existing redundant fiber optic ring to all communication points shall be in place at all times until Substantial Completion.

d. Each process area shall be permitted to have a single, non-concurrent, scheduled outage for the purpose of making PLC panel hardware modifications, loading the associated PLC logic, and its field testing/demonstration. Field testing and demonstration shall immediately follow modifications in an effort to keep scheduled shutdowns as short as possible. A 14-day period of no SCADA outage shall proceed each scheduled shutdown.

## 1.06 SUGGESTED SEQUENCE OF WORK

A. Perform the Work in the specified sequence outlined as follows or as otherwise approved by Engineer. Portions of each stage of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, and with Engineer's acceptance. Stages specified in this Section are sequence dependent.

1. Stage 1: Prior to beginning construction of the Thermal Dryer Facility building and associated Dewatered Cake Feed Station and Final Effluent Water Pump Station, Contractor shall perform the following work as described on Drawing 01-E-202:

a. Install ductbanks DB-05A and DB-05B and remove existing ductbank DB-05.

b. Install temporary fiber optic cable from local control panel (LCP) LCP-25 to LCP-24 via DB-C05A and DB-C05B and remove existing fiber optic cable between Solids Electrical Building and Dewatering Building No. 2

2. Stage 2: Construct Thermal Dryer Facility building and associated Dewatered Cake Feed Station and Final Effluent Water Pump Station

3. Stage 3: After construction of the Thermal Dryer Facility building and associated Dewatered Cake Feed Station and Final Effluent Water Pump Station is completed, install permanent fiber optic cable via existing and new ductbanks from LCP-25 to LCP-26 and from LCP-26 to LCP-24 and remove temporary fiber optic cable.

## 1.07 SHUTDOWNS

A. General

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. 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 conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

B. Treatment Process Shutdown and Site Access Constraints

1. Owner shall have the following unit processes and equipment operational at all times during the Project, unless specified herein:

a. Belt Filter Presses: Two out of three total, with the exception of the time period when Shutdown No. 1 is occurring, during which time only one belt filter press (at Dewatering Building No. 2) will be operational.

1) This includes maintaining Owner's access to move trucks with trailers in and out of the existing truck loading canopies for any belt filter presses that are operational.

b. UV Disinfection: Two channels out of three total (UV Channels 1, 2, and 4; UV Channel 3 is currently empty with no installed equipment)

1) The only period of time where it will be acceptable to only have one channel out of the three total channels operational will be during the portion of Shutdown No. 4 where the side of motor control center MCC-11 in the Compressor Building with sections 1 through 9 (which power the equipment in UV Channels 2 and 4) is out of service.

2. Owner shall have roadway access at all times to fill chemical tanks, remove dewatered sludge cake as required and access existing facilities for maintenance and operation.

3. At all times when the equipment in Dewatering Building No. 2 needs to remain in service but the Contractor needs to shut down electrical power at Dewatering Building No. 1 for longer than 4 continuous hours, existing Belt Filter Press (BFP) Feed Pump No. 3 in Dewatering Building No. 1, which pumps sludge to the BFP in Dewatering Building No. 2, must remain in service with its power supply

maintained. The Contractor shall provide temporary power provisions for BFP Feed Pump No. 3 as needed to meet this constraint. Existing BFP Feed Pump No. 3 may be completely taken out of service for a continuous duration of less than 4 hours without providing temporary power provisions.

C. Shutdowns of Electrical Systems

1. The Contractor shall prepare a sequence of construction for shutdowns of electrical systems required to accomplish the Work and shall submit it for approval by Engineer before commencing work on modifications to the electrical power system. The submittal shall include, but not be limited to, a detailed procedure for execution of work, schedule, resources, and temporary power equipment (e.g., portable generator, temporary cables and connection cabinets) as required. The Contractor shall be responsible for providing all temporary power requirements.

2. Comply with Laws and Regulations, including the National Electric Code. 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. Upon completion of shutdown Work, remove the locks and tags and notify Engineer that facilities are available for use.

3. Long-term shutdowns (4 hours or longer) of any existing electrical distribution equipment within the WPCP shall not be performed without providing temporary power provisions. The Owner will be the sole authority responsible for final approval of long-term shutdowns of existing electrical distribution equipment. Short-term shutdowns (shorter than 4 hours) for tie-ins of equipment to existing electrical power sources may be performed without providing temporary power provisions.

4. Explicit Sequencing Requirements for Critical Electrical Tasks

a. Contractor shall reroute/replace existing power feeder ductbank DB-E05 and fiber optic communication ductbank DB-C05 from Solids Electrical Building to Dewatering Building No. 2 prior to beginning construction of the Thermal Dryer Facility building.

1) Refer to the Drawings for sequencing constraints.

2) Replace and reroute power feeder conductors from switchgear SWGR-25 in Solids Electrical Building to motor control center MCC-24 (sides A & B) in Dewatering Building No. 2 via ductbanks DB-E05A and DB-E05B one side at a time.

3) Install temporary fiber optic cable from Solids Electrical Building to Dewatering Building No. 2 via ductbanks DB-C05A and DB-C05B to maintain plant fiber optic loop during construction of Thermal Dryer Facility building.

b. Provide fiber optic communication ductbanks from existing LCP-25 in Solids Electrical Building to LCP-26 in Thermal Dryer Facility building and existing LCP-24 in Dewatering Building No. 2 to replace the temporary fiber optic cable with permanent cable.

1) Refer to the Drawings for sequencing constraints.

D. Shutdowns of Communications, SCADA, and Networking

1. Permissible SCADA outages for each process area include:

a. As previously described herein, temporary fiber optic cable shall be provided from Solids Electrical Building to Dewatering Building No. 2 to maintain communications via the plant fiber optic loop. Brief communications outages are permitted during transition from permanent communications to temporary communications and vice versa. Provide shutdown plan as previously outlined herein detailing the duration of time any equipment will need to be manually operated by Owner during the changes. All temporary and permanent fiber optic cable shall be tested prior to bringing it into service.

b. LCP-11 Changes to Incorporate Final Effluent Water Pump Station: Provide shutdown plan as previously described herein detailing the duration of time the equipment controlled by LCP-11 will need to be manually operated by Owner during the changes. The control panel changes shall be implemented and tested prior to bringing modified LCP-11 back into service.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 GENERAL

A. In addition to requirements of this Section, conform to requirements of Section 01 73 00 – Demolition and Execution of Work.

B. During performance of the Work, if the Contractor needs to request that one of the two dewatering buildings be temporarily removed from service by Owner, the Owner's preference is to take Dewatering Building No. 2, which only has one existing belt filter press, out of service instead of Dewatering Building No. 1, which has two existing belt filter presses.

C. Shutdown No. 1 and Shutdown No. 2 shall not simultaneously occur. Duration between end of first shutdown (whichever one is first) and beginning of second shutdown (whichever one is later) shall be a minimum of 2 weeks.

## 3.02 GENERAL REQUIREMENTS FOR ALL SHUTDOWNS

A. Prior to Shutdown

1. Obtain Engineer's and Owner's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

2. Submit and obtain approval of all shop drawings and submittals required.

3. Coordinate with plant operations on timing of shutdown and provide required notice to Owner.

4. Bring necessary piping, couplings, valves, equipment, and/or appurtenances as applicable to the work area(s).

5. Assist Owner in preparing to take affected equipment, tanks, basins, and/or conduits temporarily out of service as applicable.

6. Coordinate other tie-ins to simultaneously be performed.

7. Install and ensure functionality of temporary system(s) as applicable.

B. During Shutdown

1. Owner will dewater tanks and basins.

2. Remove existing equipment, piping, and/or accessories as applicable and required.

3. Install all equipment, material(s), and/or systems required.

4. Work shall continue uninterrupted until it is complete.

5. Verify operation and functionality of installed equipment, material(s), and/or system(s) as applicable.

6. Following approval from Engineer, return equipment and system to permanent operation with Owner.

C. Following Shutdown

1. Verify functionality of equipment and system.

2. Verify operation of installed equipment and systems and, if applicable, verify that joints in piping are watertight or gastight as applicable.

3. If applicable, repair joints that are not watertight or gastight as applicable.

4. Remove temporary system(s) as applicable.

## 3.03 PROPOSED SHUTDOWN SEQUENCE

A. Shutdown No. 1 Description: Connection of dewatered sludge cake feed conveyor CON23104 to existing dewatered sludge cake truck loading conveyor CON23103

1. General

a. Impact on Other Equipment and Processes: This shutdown will require the Owner to cease all operations at Dewatering Building No. 1

b. Location: Dewatering Building No. 1

c. Owner Access to Site Roadways: During this shutdown, Owner's access to Dewatering Building No. 2, including the ability for trucks with trailers to reverse (i.e., back up into) the existing truck loading canopy, park beneath the canopy, and drive forward to the southeast, shall be maintained.

d. This work shall be completed in 5 continuous days.

e. Shutdown No. 1 shall not occur until the last 75-calendar-day period prior to the deadline for the Contractor to achieve Substantial Completion (i.e. days 655 through 730 of the Contract Time).

2. Specific Requirements Prior to Shutdown

a. None

3. Specific Requirements During Shutdown

a. None

4. Specific Requirements Following Shutdown

a. Confirm existing dewatered sludge cake truck loading conveyor CON23101 is capable of discharging through three of its four discharge openings (i.e., drop points), excluding the westernmost one where the conveyor was connected

b. Perform installation checkout, preliminary field tests for, final field tests for, and startup of installed conveyor in accordance with conveyor manufacturer's written procedures as specified in Section 01 75 00 – Checkout and Startup Procedures and Section 46 76 42 – Screw Conveyors.

c. Maintain Owner's access to move trucks with trailers in and out of the existing truck loading canopy and utilize the three remaining discharge

openings on existing dewatered sludge cake truck loading conveyor CON23101.

B. Shutdown No. 2 Description: Connection of dewatered sludge cake feed conveyor CON24411 to existing dewatered sludge cake truck loading conveyor CON24311

1. General

a. Impact on Other Equipment and Processes: This shutdown will require the Owner to cease all operations at Dewatering Building No. 2

b. Location: Dewatering Building No. 2

c. Owner Access to Site Roadways: During this shutdown, Owner's access to Dewatering Building No. 1, including the ability for trucks with trailers to reverse (i.e., back up into) the existing truck loading canopy, park beneath the canopy, and drive forward to the southeast, shall be maintained.

d. This work shall be completed in 5 continuous days.

e. Shutdown No. 2 shall not occur until the last 75-calendar-day period prior to the deadline for the Contractor to achieve Substantial Completion (i.e. days 655 through 730 of the Contract Time).

2. Specific Requirements Prior to Shutdown

a. None

3. Specific Requirements During Shutdown

a. None

4. Specific Requirements Following Shutdown

a. Confirm existing dewatered sludge cake truck loading conveyor CON24311 is capable of discharging through three of its four discharge openings (i.e., drop points), excluding the westernmost one where the conveyor was connected.

b. Perform installation checkout, preliminary field tests for, final field tests for, and startup of installed conveyor in accordance with conveyor manufacturer's written procedures as specified in Section 01 75 00 – Checkout and Startup Procedures and Section 46 76 42 – Screw Conveyors

c. Maintain Owner's access to move trucks with trailers in and out of the existing truck loading canopy and utilize the three remaining discharge openings on existing dewatered sludge cake truck loading conveyor CON24311.

C. Shutdown No. 3 Description: Installation of temporary bulkhead to facilitate installation of fabricated stainless steel slide gate SLG-27100 on concrete effluent channel wall and connection to 10” FE pipeline

1. General

a. Impact on Other Equipment and Processes: This shutdown will require the Owner to temporarily remove the entirety of the Ultraviolet Disinfection facility from service.

b. Location: Ultraviolet Disinfection facility

c. Owner Access to Site Roadways: Roadway directly in front of Ultraviolet Disinfection facility where construction of Final Effluent Water Pump Station will occur may be completely blocked to prevent access vehicular access by Owner through that portion of the roadway for a maximum continuous duration of 30 calendar days during performance of the work.

d. This shutdown shall only occur on a Saturday.

e. This work shall be completed in a maximum of 6 continuous hours, during which time the Owner will divert all influent flow away from the Ultraviolet Disinfection facility.

f. Contractor shall not perform any electrical work in the Compressor Building at the same time the temporary bulkhead is installed under this shutdown.

2. Specific Requirements Prior to Shutdown

a. The Owner will operate existing influent slide gates in UV channels to prevent flow from entering the work area to the greatest extent practical.

b. All installed piping shall be pressure tested prior to making the tie-in.

3. Specific Requirements During Shutdown

a. After the Owner has stopped active influent flow to the Ultraviolet Disinfection facility, the Contractor shall be responsible for transferring/ pumping any disinfected water remaining in the effluent channel to a nearby location and at a maximum flow rate as approved by the Owner.

b. Install temporary bulkhead in effluent channel between UV Channel 1 and UV Channel 2, which will prevent flow from discharging into the effluent channel from UV Channel 1.

c. Leak test temporary bulkhead to ensure no flow enters the work area.

4. Specific Requirements Following Shutdown

    a. Prior to removal of temporary bulkhead, leak test slide gate in both directions to confirm actual leakage is not more than the allowable leakage specified in Section 40 05 59.23 – Fabricated Stainless Steel Slide Gates.

    b. Perform installation checkout, preliminary field tests for, final field tests for, and startup of installed slide gate in accordance with slide gate manufacturer's written procedures as specified in Section 01 75 00 – Checkout and Startup Procedures and Section 40 05 59.23 – Fabricated Stainless Steel Slide Gates.

    c. Visually confirm piping tie-in locations do not leak prior to backfilling.

    d. Backfill excavation in accordance with requirements of Contract Documents.

D. Shutdown No. 4 Description: Installation of circuit breakers for final effluent water pumps in sections of motor control center MCC-11

    1. General

        a. Impact on Other Equipment and Processes: This shutdown will result in temporary loss of power to portions of the existing ultraviolet disinfection system equipment at the Ultraviolet Disinfection facility. At least one of the three total ultraviolet disinfection systems must remain in service at all times unless otherwise approved by Owner. If one or more of the existing ultraviolet disinfection systems is out of service for a reason not caused by Contractor, Owner reserves the right to direct Contractor to delay performance of the work until after the system(s) have been repaired and brought into service to where at least one is functional.

        b. Location: Compressor Building

        c. Owner Access

            1) Project Site Roadways: No requirements

            2) In-service side of MCC-11 where work is not actively occuring

        d. Contractor shall not perform work on both sides (i.e., sections 1 through 9 and sections 10 through 18) of MCC-11 concurrently. Two separate shutdowns will be required under Shutdown No. 4; under one shutdown, the Contractor shall install the circuit breaker in Section 8 of MCC-11 for one of the final effluent water pumps, and under the second shutdown, the Contractor shall install the circuit breaker in Section 11 of MCC-11 for the second final effluent water pump.

e. The maximum allowable continuous duration that one side of MCC-11 may be shut down for modifications is 6 hours, during which time the Owner will divert all influent flow away from the Ultraviolet Disinfection facility.

2. Specific Requirements Prior to Shutdown

a. None

3. Specific Requirements During Shutdown

a. None

4. Specific Requirements Following Shutdown

a. Repower portion of MCC-11 taken out of service

b. Perform checkout and startup of installed circuit breaker in accordance with the requirements of the Specifications and the manufacturer's recommendations

E. Shutdown No. 5 Description: Tie-ins to existing 6" Potable Water (PW) pipelines

1. General

a. Impact on Other Equipment and Processes: This shutdown will likely result in temporary low pressure in the WPCP's PW network for a limited time period.

b. Location: Yard

c. Owner Access to Site Roadways: No requirements

d. The maximum allowable continuous duration that the existing 6" PW network may be shut down to stop PW service in the vicinity of the tie-in locations for the Contractor to complete the work is 4 hours. The Contractor shall coordinate with the Owner, who will close (and subsequently reopen) existing valves on the 6" PW pipelines and/or other existing PW pipelines in the vicinity of the tie-in locations, to minimize the portion of the existing PW distribution network at the WPCP that is isolated for performance of the work.

2. Specific Requirements Prior to Shutdown

a. All installed piping shall be pressure tested prior to making the tie-in.

3. Specific Requirements During Shutdown

a. None

4. Specific Requirements Following Shutdown

   a. Visually confirm piping tie-in locations do not leak prior to backfilling.

   b. Confirm PW flow is “active” and reaches all discharge locations and appurtenances at Thermal Dryer Facility.

   c. Backfill excavation in accordance with requirements of Contract Documents.

   d. Backfill the tie-in location in accordance with requirements of Contract Documents.

**END OF SECTION**

## SECTION 01 20 00
## MEASUREMENT AND PAYMENT

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes

1. Items listed in 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. 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.

3. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents.

4. Each lump sum and unit price stated in the Bid Schedule shall constitute full compensation for each item of the Work completed. The Contractor shall provide all labor, materials, tools, equipment, and services required to complete the Work, as specified and shown in the Contract Documents. Each lump sum and unit bid price shall include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

5. Payment for the various items in the Schedule of Payment items, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of the Work being described, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of OSHA. Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.

6. The Contractor‘s attention is called to the fact that the quotations for the various items of the Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of the Work has not been established by the Schedule of Payment items or this Section, they shall

include the cost for that item of the Work in some other applicable bid item, so that their proposal for the Project does reflect their total price for completing the Work in its entirety.

B. Related Sections

1. Payments to Contractor: Refer to General Conditions, Supplementary Conditions, and Agreement.

2. Changes to Contract Price: Refer to General Conditions, Supplementary Conditions, and Section 01 26 00 – Contract Modification Procedures.

3. Schedule of Values: Refer to General Conditions, Supplementary Conditions, and Section 01 29 73 – Schedule of Values.

## 1.02 ENGINEER'S ESTIMATE OF QUANTITIES

A. Engineer's and Owner's estimated quantities for unit price pay items, as listed in the Bid Form, are approximate only and are included solely for the purpose of comparison of Bids. Owner does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required will correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity as Owner may deem necessary. Contractor will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensation for any additions caused by changes or alterations in the Work ordered by Owner.

## 1.03 PAYMENT

A. The Contractor shall submit a Preliminary Progress Schedule for review as specified in Section 01 32 00 – Construction Progress Schedule, and Section 01 31 19 – Project Meetings. The Preliminary Progress Schedule shall include a Detailed Cost Breakdown and Schedule of Values for the Work for the purpose of making progress payments during the construction period. The Contractor shall not submit a Progress Payment Request (Application for Payment) until the Preliminary Progress Schedule has been approved.

B. The Detailed Cost Breakdown and Schedule of Values for the Work shall be given in sufficient detail for proper identification of items of the Work accomplished. The Detailed Cost Breakdown and Schedule of Values for the Work shall complement the items of the Work detailed in the construction progress schedule in order to accurately relate construction progress to the requested payment. Each item shall include its proportional share of all costs including the Contractor's overhead, contingencies, and profit. The sum of all scheduled items shall equal the total value of the Contract.

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C. If the Contractor anticipates the need for payment for materials stored on the project site or off-site bonded warehouse, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the items of the Work in the Detailed Cost Breakdown and Schedule of Values for the Work. Similar procedures shall be employed for undelivered specifically manufactured equipment and material as specified herein.

## 1.04 ADMINISTRATIVE REQUIREMENTS

A. Contractor shall include all additional items, services, goods, resources, and manpower necessary for installation of the Work to provide a completely functional system in accordance with the Contract Documents. Contractor shall include these costs associated with providing a completely functional system within the listed items on the Bid Form and as specified herein.

1. ITEM 1 – LUMP SUM WORK

    a. Lump sum bid price shall include all costs for furnishing all products, materials, taxes, and equipment and performing all labor necessary to complete and put into operation the Fitzgerald Creek WPCP Thermal Dryer Facility Project, including, but not limited to: demolition of existing facilities, construction of new facilities, modifications to existing facilities, dewatering, cleaning, debris disposal, groundwater control, concrete, structural steel, metal fabrications and systems, equipment, plumbing, HVAC, electrical, earthwork, site work, paving, piping, fittings, valves, and all other work necessary for a complete and fully functioning system, as specified and shown in the Contract Documents, whether specifically mentioned or implied, except that work specifically included for payment under any other Bid Item.

    b. Where the Specifications and/or Drawings are silent on payment for work specified under an individual Specification Section or shown on the Drawings, it is understood that payment will be made as part of the lump sum bid price.

    c. Payment for all Lump Sum work shown or specified in the Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

2. ITEM 2 – PRE-NEGOTIATED COSTS FOR SOLE-SOURCED EQUIPMENT AND SERVICES

    a. The Owner has pre-negotiated the scope of supply and cost for equipment and services with a sole-sourced Manufacturer/Provider/Supplier as listed

under Bid Item No. 2.1. A copy of the Manufacturer's/Provider's/Supplier's scope letter (i.e., proposal or quotation) is included at the end of the referenced Specification Section.

b. The Owner's pre-selection and pre-negotiation of this equipment and services shall in no way be construed to change, in any material way, Contractor's responsibilities under the terms and conditions of this Contract.

c. All costs for compliance with the terms of the Contract which are different than or not covered under the pre-negotiated scope of supply and cost, including taxes, shall be included in the Contractor's lump sum bid (Bid Item No. 1 – LUMP SUM WORK).

d. Payment for sole-sourced equipment and services will be made in accordance with the scope letter (i.e., proposal or quotation), Section 00 72 00 – General Conditions, Section 00 73 00 – Supplementary Conditions, Section 01 29 73 – Schedule of Values, and Section 01 29 76 – Progress Payment Procedures.

3. ITEM 3 – CASH ALLOWANCES

a. Cash allowances will be administered in accordance with Paragraph 11.02 of General Conditions and the Supplementary Conditions. Owner-directed work shall be accomplished by increasing resources on the Project so as not to impact the overall Project Schedule. Time extensions will not be given for Owner-directed work unless the new work can be shown to directly impact the critical path of the Project.

b. Cash allowances are further described as follows:

1) Bid Item No. 3.1 – Owner-Directed Work Items: Allow the amount provided in the Bid for additional work authorized by the Owner that is outside the original scope of work of this Contract. The Owner will issue a written Supplemental Work Authorization (SWA) to incorporate cost or schedule changes into the Contract. The SWA shall be used for increases and decreases in the Contract price, within the amount set forth in the Bid, or to make changes in schedule for performance of the Work. An SWA shall authorize the Contractor to perform changes in the Work. The Contractor shall not start on SWA work until the Contractor receives a fully authorized, written SWA form, signed by the appropriate Owner personnel; the Contractor shall not consider verbal statements as authorization to proceed with the changes. The Contractor should not expect that any SWAs will be issued. Owner will have no obligation to pay for SWA work unless the same is performed pursuant to a written SWA form signed before the SWA work is commenced.

2) The Owner-Directed Work Allowance for the Project will be $800,000.

4. ITEM 4 – UNIT PRICE WORK (ADDITIONAL WORK IF ORDERED BY ENGINEER)

a. Payment for unit price items covers all the labor, materials, and services necessary to furnish and install the following items for additional work not shown on the Drawings or specified in the Specifications, except where explicitly stated as follows and if ordered by the Engineer

1) Bid Item No. 4.1 – Additional Mill and Resurface: Payment for Bid Item No. 4.1 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional Mill and Resurface which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.1 shall include all materials, equipment, labor, indirect costs, and profit to provide additional milling and asphalt pavement resurfacing, meeting all requirements of the Contract Documents, including hauling and disposal of milled asphalt, restriping the road and all necessary incidentals required to complete the work. Measurement for Bid Item No. 4.1 will be by square yard of area paved and will be measured in place.

2) Bid Item No. 4.2 – Additional Asphalt, Full Depth: Payment for Bid Item No. 4.2 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional Asphalt Paving, Full Depth which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.2 shall include all materials, equipment, labor, indirect costs, and profit to provide additional full-depth asphalt pavement (binder course, tack coat, and wearing course) meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.2 will be by square yard of asphalt paving placed and will be measured in place.

3) Bid Item No. 4.3 – Additional Concrete Paving, Full Depth: Payment for Bid Item No. 4.3 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional Concrete Paving, Full Depth which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.3 shall include all materials, equipment, labor, indirect costs, and profit to provide full depth concrete paving meeting all requirements of the Contract Documents. Graded aggregate base (GAB) material associated with concrete paving shall not be included in this unit cost. Measurement for Bid Item No. 4.3 will

be by square yard of concrete paving placed and will be measured in place.

4) Bid Item No. 4.4 – Additional Concrete Paving, Trench Repair: Payment for Bid Item No. 4.4 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional Concrete Paving, Trench Repair which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.4 shall include all materials, equipment, labor, indirect costs, and profit to provide additional concrete paving for trench repair meeting all requirements of the Contract Documents, including saw cutting, concrete trench cap and all necessary incidentals required to complete the work. Measurement for Bid Item No. 4.4 will be by square yard of concrete paving placed and will be measured in place.

5) Bid Item No. 4.5 – Additional Select Fill: Payment for Bid Item No. 4.5 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional Select Fill which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.5 shall include all materials, equipment, labor, indirect costs, and profit to provide select fill, including compaction, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.5 will be by cubic yard of compacted select fill and will be measured in place.

6) Bid Item No. 4.6 – Additional Graded Aggregate Base (GAB) for Subgrade Select Fill: Payment for Bid Item No. 4.6 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional Graded Aggregate Base (GAB) for Subgrade Select Fill beneath structures and roadways which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.6 shall include all materials, equipment, labor, indirect costs, and profit to provide GAB, including compaction, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.6 will be by cubic yard of compacted GAB and will be measured in place.

7) Bid Item No. 4.7 – Additional #57 Stone: Payment for Bid Item No. 4.7 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide Additional #57 Stone as which, in the sole judgment of the Engineer, could not have been determined from the Bidding Documents. Bid Item No. 4.7 shall include all materials, equipment, labor, indirect costs, and profit to provide #57 stone, including compaction, meeting all requirements of the Contract

Documents. Measurement for Bid Item No. 4.7 will be by cubic yard of compacted #57 stone and will be measured in place.

8) Bid Item No. 4.8 – Additional Type I Separator Geotextile: Payment for Bid Item No. 4.8 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment for providing Type I separator geotextile beneath structures and roadways, between soil backfill and different sizes of stone/gravel, and other locations as directed by the Engineer which, in the sole judgement of the Engineer, could not have been determined from the Bidding Documents. Bid Item 4.8 shall include all materials, equipment, labor, indirect costs, and profit to provide Type I separator geotextile, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.8 will be by square yard of Type I separator geotextile and will be measured in place.

9) Bid Item No. 4.9 – Additional No. 16 AWG Shielded, Twisted Pair Cables: Payment for Bid Item No. 4.9 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide a No. 16 AWG shielded, twisted pair cable which, in the sole judgement of the Engineer, could not have been determined from the Bidding Documents. Bid Item 4.9 shall include all materials, equipment, labor, indirect costs, and profit to provide and terminate a No. 16 AWG shielded, twisted pair cable, provide identification and pulling lubricants, and test the device signal, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.9 will be by linear foot of No. 16 AWG shielded, twisted pair cable provided and will be measured in place.

10) Item No. 4.10 – Additional No. 14 AWG Wires: Payment for Bid Item No. 4.10 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide a No. 14 AWG wire which, in the sole judgement of the Engineer, could not have been determined from the Bidding Documents. Bid Item 4.10 shall include all materials, equipment, labor, indirect costs, and profit to provide and terminate a No. 14 AWG wire, provide identification and pulling lubricants, and test the device signal, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.10 will be by linear foot of No. 14 AWG wire installed and will be measured in place.

11) Item No. 4.11 – Additional 1” Rigid Galvanized Steel Conduits: Payment for Bid Item No. 4.11 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide 1” rigid galvanized steel conduit which, in the sole judgement of the Engineer, could not have been determined from the Bidding

Documents. Bid Item 4.11 shall include all materials, equipment, labor, indirect costs, and profit to provide 1” rigid galvanized steel conduit, including fittings, couplers, and connectors as necessary, provide identification, and test the conduit, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.11 will be by linear foot of 1” rigid galvanized steel conduit installed and will be measured in place.

12) Item No. 4.12 – Additional 1” Schedule 40 Rigid Nonmetallic PVC Conduits: Payment for Bid Item No. 4.12 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide 1” Schedule 40 rigid nonmetallic PVC conduit which, in the sole judgement of the Engineer, could not have been determined from the Bidding Documents. Bid Item 4.12 shall include all materials, equipment, labor, indirect costs, and profit to provide 1” Schedule 40 rigid nonmetallic PVC conduit, including fittings, couplers, and connectors as necessary, provide identification, and test the conduit, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.12 will be by linear foot of 1” Schedule 40 rigid nonmetallic PVC conduit installed and will be measured in place.

13) Item No. 4.13 – Additional 1” PVC-Coated Rigid Galvanized Steel Conduits: Payment for Bid Item No. 4.13 will be made according to the unit price in Article 5 of the Bid Form, which shall constitute full payment to provide 1” PVC-coated rigid galvanized steel conduit which, in the sole judgement of the Engineer, could not have been determined from the Bidding Documents. Bid Item 4.13 shall include all materials, equipment, labor, indirect costs, and profit to provide 1” PVC-coated rigid galvanized steel conduit, including fittings, couplers, and connectors as necessary, provide identification, and test the conduit, meeting all requirements of the Contract Documents. Measurement for Bid Item No. 4.13 will be by linear foot of 1” PVC-coated rigid galvanized steel conduit installed and will be measured in place.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 PAYMENT

A. The total Bid Price for the Contract shall include, as applicable, the following items:

1. Lump Sum Contract Item(s) as specified: Items 1, 2, and 3

2. Unit Price Contract Item(s) as specified: Item 4

B. Payment for the total bid price will be made in accordance with the requirements of the Contract Documents.

**END OF SECTION**

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# SECTION 01 25 00
# SUBSTITUTION PROCEDURES

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Procedural requirements for product substitutions

2. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified

B. Requests for substitutions of equipment and material shall conform to the requirements of the General Conditions and Supplemental Conditions.

C. Procedure for substitution requests and review including evaluation, reimbursement, acceptance, and determination shall be in accordance with General Conditions and Supplemental Conditions.

### 1.02 REFERENCES

A. Definitions: The following words or terms are not defined but, when used in this Section, have the following meaning:

1. “Products” includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include Owner-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Contractor’s Responsibilities: In submitting request for substitution, Contractor represents that:

1. Contractor has investigated proposed substitution and determined that it is equivalent to item, product, method, or procedure specified, as applicable.

2. Contractor will provide the same or better guarantees or warranties for proposed substitution as for the specified product, manufacturer, method, or procedure, as applicable.

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3. Contractor waives all claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

B. Engineer's Review: A proposed substitution 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 request for substitution.

C. If Engineer does not approve the proposed substitute, Contractor shall provide the specified product, manufacturer, method, or procedure, as applicable.

D. Approval of a substitution request will not relieve Contractor from requirement for submitting shop drawings as set forth in the Contract Documents.

E. Product Substitutions Procedure

1. Requests for approval of substitute or "or equal" products or items will be considered for a period of 30 days after the Effective Date of the Agreement. After end of specified period, requests will be considered only in case of unavailability of a specified product or other conditions beyond Contractor's control.

2. Submit two hard copies of request for substitution.

3. Submit separate request for each substitution.

4. In addition to requirements of the General Conditions and information required on substitution request forms, include the following with request:

a. Product identification, including manufacturer's name and address

b. Manufacturer's literature with product description, performance and test data, and reference standards with which product complies

c. Samples, if appropriate

d. Name and address of similar projects on which product was used and date of installation

e. Certified tests, where applicable, by an independent laboratory attesting the proposed substitution is equal

f. Cost information for the proposed substitution and the specified products

g. Lead time information for the proposed substitution and specified products

h. All other submittal requirements indicated in the individual Specification Sections associated with the specified equipment and material

F. Construction Methods Substitutions Procedures

1. Where construction methods or procedures are specified, for a period of 30 days after the Effective Date of the Agreement, Engineer will consider Contractor's written requests for substitute construction methods or procedures specified.

2. Submit two hard copies of request for substitution.

3. Submit separate request for each substitution.

4. In addition to requirements of the General Conditions and information required on substitution request forms, include the following with request:

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

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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# SECTION 01 26 00
# CONTRACT MODIFICATION PROCEDURES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Section Includes:

1. General Conditions and Supplementary Conditions provision expansion, including the following:

a. Requests for Interpretation

b. Field Orders

c. Work Change Directives

d. Requests for Proposal

e. Change Proposals

f. Change Orders

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Submit Contract modification documents to Engineer's contact person and address in the Contract Documents.

B. Retain at Contractor's office and at the Site complete copy of each Contract modification document and related documents and Engineer's response.

### 1.03 REQUESTS FOR INTERPRETATION

A. General

1. Submit electronic requests for interpretation to Engineer via Autodesk Construction Cloud Build (ACC Build) (or alternate agreed-upon contract management software). Contractor and Owner may submit requests for interpretation.

2. Submit request for interpretation to obtain clarification or interpretation of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents using requests for interpretation.

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3. Do not submit request for interpretation when other form of communication is appropriate, such as submittals, requests for substitutions or "or equals", notices,

ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action.

B. Procedure

1. Submit one copy (electronic) of each request for interpretation via ACC Build (or alternate agreed-upon contract management software). Submit each request for interpretation with separate letter of transmittal if hard copies are submitted.

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. Copy of log will be provided upon request.

4. Engineer will provide written response to each request for interpretation. One copy of Engineer's response will be distributed to:

a. Contractor

b. Owner

c. Engineer

d. Engineer's Resident Project Representative (RPR)

C. If Engineer requests additional information to make an interpretation, provide information requested within 10 days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.

D. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required, notify Engineer in writing before proceeding with the Work associated with the request for interpretation.

E. Submit each request for interpretation on a form acceptable to Engineer.

1. Contractor shall attach Portable Document Format (.pdf) file through ACC Build that adheres to the following guidelines.

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.

3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail for engineer's response.

4. When applicable, request for interpretation shall include Contractor's recommended resolution.

## 1.04 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 (EJCDC) document C-942, "Field Order" or other Engineer's accepted form.

4. Engineer will maintain a log of Field Orders issued.

B. Procedure

1. Electronic copies of Field Orders will be maintained, stored, and distributed by electronic construction document management system.

2. If Contractor or Owner believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, immediately notify Engineer in writing before proceeding with the Work associated with the Field Order.

3. If the Field Order is unclear, submit request for interpretation.

## 1.05 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 negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

3. Work Change Directives will be in the form of EJCDC document C-940, "Work Change Directive" or other Engineer's accepted form.

B. Procedure

1. Three originals of Work Change Directive signed by Owner and Engineer will be furnished to Contractor, who shall promptly sign each original Work Change Directive and, within 5 days of receipt, return all originals to Engineer.

2. Original, signed Work Change Directives will be distributed as follows:

   a. Contractor: One original

   b. Owner: One original

   c. Engineer: One original

3. One hard copy of each Work Change Directive will be distributed to Engineer's RPR.

4. When required by Engineer, document for the Work performed under each separate Work Change Directive, for each day, the number and type of workers employed and hours worked; equipment used including manufacturer, model, and year of equipment, and number of hours; materials used, receipts for and descriptions of materials and equipment incorporated into the Work, invoices and labor and equipment breakdowns for Subcontractors and Suppliers, and other information required by Owner or Engineer, in a format acceptable to Engineer. Submit this documentation to Engineer as a Change Proposal.

## 1.06 REQUESTS FOR PROPOSAL

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. One hard copy of each signed proposal request will be furnished to Contractor with one copy each to:

   a. Owner

   b. Engineer

c. Engineer's RPR

2. Submit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in proposal request.

3. Upon receipt of proposal request, Contractor shall prepare and submit a Change Proposal, in accordance with this Section, for the proposed Work described in the proposal request.

## 1.07 CHANGE PROPOSALS

A. General

1. Submit written Change Proposal to Engineer in response to each proposal request and when Contractor believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required.

B. Procedure

1. Submit to Engineer one original and one copy of each Change Proposal with accompanying documentation and simultaneously submit two copies to Owner. Submit each Change Proposal with separate letter of transmittal.

2. Engineer will review Change Proposal and either request additional information from Contractor or provide to Owner recommendation regarding approval of the Change Proposal.

3. When Engineer requests additional information to render a decision, submit required information within 5 days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to Change Proposal number.

4. Upon completing review, one copy of Engineer's written response, if any, will be distributed to:

a. Contractor

b. Owner

c. Engineer

d. Engineer's RPR

5. If Change Proposal is recommended for approval by Engineer and approved by Owner, a Change Order will be issued.

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 and the Supplementary Conditions.

C. Each Change Proposal shall be submitted on a Change Proposal form acceptable to Engineer.

1. 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 23” would be, “Proposal No. 23-001”.

2. In space provided on 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 Change Proposal Request No.” followed by the proposal request number. Provide written clarifications, if any, to scope of change.

b. Provide justification for each proposed change. If change is in response to proposal request, write in as justification, “In accordance with Change Proposal Request No.” followed by the proposal request number.

c. List the total change in the Contract Price and Contract Times for each proposed change.

3. 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

c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each

d. Detailed breakdown of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier’s written quotations

e. 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

f. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions

g. Other information required by Engineer

h. Contractor's fees applied to eligible Contractor costs and eligible Subcontractor costs

## 1.08 CHANGE ORDERS

A. General

1. Change Orders will be recommended by Engineer and 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 document C-941, "Change Order" or other Engineer's accepted form.

B. Procedure

1. Five originals of each Change Order will be furnished to Contractor, who shall sign each original Change Order and return all originals to Engineer within 5 days of receipt.

2. Engineer will sign each original Change Order and forward them to Owner.

3. After approval and signature of all parties, three executed original copies will be returned to Engineer. Engineer will distribute as follows:

a. Contractor: One original

b. Owner: One original

c. Engineer: One original

4. One copy of each Change Order will be distributed to Engineer's RPR.

# PART 2 – PRODUCTS (NOT USED)

# PART 3 – EXECUTION

## 3.01 SCHEDULE

A. 2018 EJCDC Form C-942, Field Order

B. 2018 EJCDC Form C-940, Work Change Directive

C. 2018 EJCDC Form C-941, Change Order

**END OF SECTION**

**FIELD ORDER NO.: [Number of Field Order]**

| | |
|---|---|
| Owner: | Owner's Project No.: |
| Engineer: | Engineer's Project No.: |
| Contractor: | Contractor's Project No.: |
| Project: | |
| Contract Name: | |
| Date Issued: | Effective Date of Field Order: |

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

**Reference:**

Specification Section(s):

Drawing(s) / Details (s):

**Description:**

**[Description of the change to the Work]**

**Attachments:**

**[List documents supporting change]**

**Issued by Engineer**

By: _____

Title: _____

Date: _____


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**WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]**

| | |
|---|---|
| Owner: | Owner's Project No.: |
| Engineer: | Engineer's Project No.: |
| Contractor: | Contractor's Project No.: |
| Project: | |
| Contract Name: | |
| Date Issued: | Effective Date of Work Change Directive: |

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

Description:

**[Description of the change to the Work]**

Attachments:

**[List documents related to the change to the Work]**

Purpose for the Work Change Directive:

**[Describe the purpose for the change to the Work]**

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

**Notes to User—Check one or both of the following**

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

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

Contract Price: $ _____ **[increase] [decrease] [not yet estimated]**.

Contract Time: _____ days **[increase] [decrease] [not yet estimated]**.

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

| | Recommended by Engineer | Authorized by Owner |
|---|---|---|
| By: | | |
| Title: | | |
| Date: | | |

**EJCDC® C-940, Work Change Directive.**
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**CHANGE ORDER NO.: [Number of Change Order]**

Owner: Owner's Project No.:
Engineer: Engineer's Project No.:
Contractor: Contractor's Project No.:
Project:
Contract Name:
Date Issued: Effective Date of Change Order:

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

Description:

**[Description of the change]**

Attachments:

**[List documents related to the change]**

| **Change in Contract Price** | **Change in Contract Times [State Contract Times as either a specific date or a number of days]** |
|---|---|
| Original Contract Price:<br>$ _____ | Original Contract Times:<br>Substantial Completion: _____<br>Ready for final payment: _____ |
| **[Increase] [Decrease]** from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**:<br>$ _____ | **[Increase] [Decrease]** from previously approved Change Orders No.1 to No. **[Number of previous Change Order]**:<br>Substantial Completion: _____<br>Ready for final payment: _____ |
| Contract Price prior to this Change Order:<br>$ _____ | Contract Times prior to this Change Order:<br>Substantial Completion: _____<br>Ready for final payment: _____ |
| **[Increase] [Decrease]** this Change Order:<br>$ _____ | **[Increase] [Decrease]** this Change Order:<br>Substantial Completion: _____<br>Ready for final payment: _____ |
| Contract Price incorporating this Change Order:<br>$ _____ | Contract Times with all approved Change Orders:<br>Substantial Completion: _____<br>Ready for final payment: _____ |

| Recommended by Engineer (if required) | Accepted by Contractor |
|---|---|
| By: _____ | _____ |
| Title: _____ | _____ |
| Date: _____ | _____ |
| Authorized by Owner | Approved by Funding Agency (if applicable) |
| By: _____ | _____ |
| Title: _____ | _____ |
| Date: _____ | _____ |


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# SECTION 01 29 73
# SCHEDULE OF VALUES

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. General requirements for preliminary and final Schedule of Values

2. Schedule of Values and the Progress Schedule updates specified in Section 01 32 00 – Construction Progress Schedule shall be the basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. General Requirements

1. 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. List purchase and delivery costs for materials and equipment for which Contractor may apply for payment as stored materials.

   a. Line items for work to be done by Subcontractors shall reference "(Subcontractor)" in the associated description.

2. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.

3. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems as appropriate or when requested by Engineer.

4. Include unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by Engineer.

5. Include itemized list of Work for each major part of the Contract for each payment item specified in Section 01 20 00 – Measurement and Payment.

6. Include columns for the following for each line item at a minimum: item number, description of work, scheduled value (quantity, unit price, and total amount), work in-place on previous applications (quantity and total amount), work in-place during the current period (quantity and total amount), total completed to date of

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application (quantity and total amount), and balance to complete (quantity and total amount).

7. 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.

B. Specific Requirements

1. 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).

2. Include separate line item for each allowance and for each unit price item

3. Include line item for bonds and insurance in amount not exceeding the values specified in Section 00 73 00 – Supplementary Conditions. This may be applied for in the first Application for Payment in accordance with Paragraph 14.01 of Section 00 73 00 – Supplementary Conditions.

4. Include 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 schedule accepted by Engineer.

5. Line items for Site maintenance such as erosion and sedimentation control, 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.

6. 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.

   a. Mobilization: Reference Paragraph 14.01C of Section 00 73 00 – Supplementary Conditions.

   b. Demobilization shall be at least 1% of the Contract Price and shall be included with the Application for Payment following Substantial Completion or other schedule accepted by Engineer.

7. Separate line items shall be included for the costs of submittals for equipment and materials, Operation and Maintenance (O&M) Manuals for equipment, field testing

for equipment and materials, and training for equipment (if specified) as follows, unless otherwise accepted by Engineer:

a. A maximum of 5 percent of total cost (including overhead and profit) of each item of equipment and material may be apportioned to submittal preparation and finalization, and corresponding payment may be requested in the next Application for Payment following Engineer providing acceptable submittal review disposition (i.e., annotated “Furnish as Submitted” or “Furnish as Corrected”) and Contractor providing hard copies of acceptable submittal to Engineer for record purposes.

b. A minimum of 3 percent of total cost (including overhead and profit) of each item of equipment shall be apportioned to O&M Manual preparation and finalization, and corresponding payment may be requested in the next Application for Payment following Engineer providing acceptable O&M Manual review disposition (i.e., annotated “Furnish as Submitted” or “Furnish as Corrected”) and Contractor providing final O&M Manual copies to Engineer.

c. A minimum of 5 percent of total cost (including overhead and profit) of each item of equipment and material (where applicable) shall be apportioned to final field testing, and corresponding payment may be requested in the next Application for Payment following Engineer’s acceptance of the associated written site testing report(s).

d. A minimum of 3 percent of total cost (including overhead and profit) of each item of equipment shall be apportioned to training of operations and maintenance personnel (including planning, attending (including travel expenses), and conducting sessions) and corresponding payment may be requested in the next Application for Payment following successful completion of training to the satisfaction of Owner and Engineer. This requirement only applies if training is required for the specific item of equipment as specified in Section 01 79 00 – Instruction of Owner’s Personnel and/or the individual Specification Section for the item of equipment.

e. Where terms and conditions contained in an individual scope letter (i.e., proposal or quotation) for pre-negotiated equipment and professional services included as a supplement to a Specification Section differ from the previously listed percentages of total cost with respect to submittal preparation and finalization (i.e., approval), field testing, and/or training (if specified), the terms and conditions in the individual scope letter (i.e., proposal or quotation) shall take precedence.

f. Where “equipment” is previously referenced in requirements for the Schedule of Values, it shall apply to equipment permanently incorporated

into the Work as provided under Division 13 – Special Construction; Division 21 – Fire Suppression; Division 22 – Plumbing; Division 23 – Heating, Ventilating, and Air Conditioning (HVAC); Division 26 – Electrical; Division 28 – Electronic Safety and Security; Division 40 – Process Interconnections; Division 41 – Material Processing and Handling Equipment; Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment; and Division 46 – Water and Wastewater Equipment of the Specifications.

g. Where “material” is previously referenced in requirements for the Schedule of Values with respect to submittal preparation and finalization, it shall only apply to material for which a Project-specific shop drawing must be prepared and submitted and shall not apply to material that only requires previously existing manufacturer’s pre-printed literature, cutsheets, etc. to be submitted.

C. Preliminary Schedule of Values: 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 resubmittals until Schedule of Values is acceptable.

D. Time Frame for Submittals

1. Submit preliminary Schedule of Values within 10 days of date that the Contract Times commence running in accordance with the Notice to Proceed.

2. Submittal of the Schedule of Values shall be in accordance with the General Conditions and Supplementary Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.

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

## 1.03 SUBMITTALS

A. Submit the following:

1. Five hard copies and two electronic copies (in Portable Document Format (.pdf) and Microsoft Excel .xlsx file formats) of preliminary Schedule of Values

2. Five hard copies and two electronic copies (in .pdf and Microsoft Excel .xlsx file formats) of Schedule of Values

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 01 29 76
## PROGRESS PAYMENT PROCEDURES

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Administrative and procedural requirements for progress payment to the Contractor by the Owner

B. Related Sections

1. Section 01 77 19 – Closeout Requirements

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. General: Contractor's request for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.

B. Procedure

1. Review with Engineer's 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. Submit to Engineer two originals of each complete draft Application for Payment and other documents to accompany the Application for Payment for review.

3. Revise Application for Payment according to Engineer's and Engineer's RPR's comments and submit one electronic copy (Portable Document Format (.pdf) file) of the complete revised final 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. Requirements

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. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions. Legibly indicate on invoice or bill of sale the specific

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materials or equipment included in the payment request and corresponding bid/payment item number for each.

3. Contractor's Affidavit is required for payment application and requests beginning with the second Application for Payment.

4. For payment requests that include payment for work under an allowance, submit documentation acceptable to Owner of the authorization of allowance work.

5. For payment requests (other than request for final payment) that include reduction or payment of retainage in an amount greater than that required in the Contract Documents, submit on form acceptable to Owner consent of surety to partial release or reduction of retainage.

6. Payment(s) will be withheld if Record Documents are not updated.

7. With each Application for Payment, submit Progress Schedule update that coincides with the end of the payment period.

D. Sales Tax Report

1. A Sales Tax Report, which will be used to officially document the state of Georgia sales tax expended in the procurement of treatment equipment, shall be included with each month's Application for Payment. The report shall be developed in Microsoft Excel (.xlsx) file format and shall include each equipment item purchased, the facility in which it will be or 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 shall be expanded to serve as a cumulative summary of the treatment equipment installed.

2. The format and content of the report shall be as follows:

    a. The report shall be sorted by Area and Structure number in ascending order.

    b. Column 1 – "Location": Identifies the locationn of the inventory included for that area of the facility

    c. Column 2 – "Description": Identifies the specific item being documented, including the structure/facility/building itself and all equipment items within the structure/facility/building or area (e.g., heating and ventilation equipment, backwash air scour blowers), all system components (e.g., transformers, variable frequency drives, motor control centers) and all tagged/numbered/discretely identified items or components (e.g., valves, pumps, power panels)

d. Column 3 – “Manufacturer”: Identifies the manufacturer of the specific item

e. Column 4 – “Date of Sale”: Identifies the date that the invoice for the individual equipment item/component/system was paid

f. Column 5 – “Item Cost”: Identifies the actual cost of the specific item prior to the application of sales tax

g. Column 6 – “Sales Tax Paid”: Identifies the actual state of Georgia sales tax paid for the specific item

3. Each Structure and Area shall have a subtotal line wherein the individual items are summed to develop a Structure/Area value, and the Area subtotals shall be summed to establish a total state of Georgia sales tax value paid for the work.

4. The monthly Sales Tax Report shall be accompanied by certified copies of invoices showing each item’s costs and taxes paid and a copy of the checks used for payment.

5. The Sales Tax Report shall be submitted in both hard copy and electronic copy (Microsoft Excel .xlsx) file format. Electronic copy shall be submitted via email.

E. Requirements for request for final payment are in the General Conditions, as modified by the Supplementary Conditions, and Section 01 77 19 – Closeout Requirements.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 01 31 19
## PROJECT MEETINGS

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Pre-Construction Meeting

a. 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. Matters requiring coordination will be discussed and procedures for handling such matters will be established.

b. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. Engineer will establish the date, time, and location of conference and notify the interested and involved parties.

2. Progress Meetings

a. Progress meetings will be held throughout the Project. Contractor shall attend each progress meeting prepared to discuss in detail all items on the agenda.

b. Engineer will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

c. Date, Time and Location

1) Regular Meetings: Every month on a day and time agreeable to Owner, Engineer, and Contractor

2) Weekly Meetings: Every week on a day and time agreeable to Owner, Engineer, and Contractor

3) Engineer's Field Office at the Site or other location mutually agreed upon by Owner, Engineer, and Contractor.

d. Additional meetings may be conducted as progress of Work requires at a mutually agreed date, time and location.

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## 1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Construction Meeting

1. Contractor shall provide Pre-Construction Meeting submittals with sufficient number of copies for each attendee.

2. Required Attendees

a. Contractor

1) Project Manager

2) Site Superintendent

3) Safety Representative

4) Major Subcontractors (if needed)

a) Electrical

b) Instrumentation

b. Owner

c. Engineer

d. Engineer's Resident Project Representative (RPR)

e. Representatives of governmental or other regulatory agencies (if needed)

3. Contractor shall prepare and submit a health and safety plan, including confined space entry plan in accordance with Section 01 35 20 – Confined Space Entry Plan, as specified in this Section prior to the Pre-Construction Meeting.

4. Minimum Agenda

a. Procedural Requirements

1) Designation of responsible personnel

2) Use of Site and Owner's requirements, including general regards for community relations

3) Delivery of materials and equipment to the Site

4) Safety and first aid procedures

5) Confined space entry plan

6) Security procedures

7) Housekeeping procedures

b. Administrative Requirements

1) Distribution of Contract Documents

2) Shop drawing submittal procedures

3) Maintaining record documents at the Site

4) Contract modification procedures

5) Processing of Applications for Payment

c. Site Mobilization Requirements

1) Working hours, overtime, and holidays

2) Field offices, trailers, and staging areas

3) Temporary facilities and utilities, including usage and coordination

4) Temporary controls, such as erosion and sedimentation control, noise, dust, stormwater, and other measures

5) Access to Site, access roads, and parking for construction vehicles

6) Protection of traffic and existing property, including site barriers and temporary fencing

7) Security

8) Storage of materials and equipment

9) Reference points and benchmarks, surveys and layouts

10) Site maintenance during the Project, including cleaning and removal of trash and debris

11) Site restoration

d. Schedules

1) Preliminary construction

2) Critical work sequencing

3) Preliminary shop drawing submittals

4) Preliminary Schedule of Values

B. Monthly Progress Meetings

1. Monthly progress meetings frequency shall be conducted as specified in this Section, unless modified and agreed upon by Owner, Engineer, and Contractor. Additional meetings may be conducted as progress of Work requires.

2. Contractor shall provide submittals specified in this Section prior to each monthly progress meeting.

3. Attendance

a. Contractor, including Project Manager, Site Superintendent, Safety Representative, and representatives of Subcontractors and Suppliers as required.

b. Engineer, including project manager (or designated representative), RPR (if any), and others as required by Engineer

c. Owner

d. Subcontractors, only with Engineer’s approval or request, as required in the agenda

4. Agenda shall be developed and distributed via Autodesk Construction Cloud Build (ACC Build) contract management software. Agenda shall include at a minimum:

a. Review, comment, and amendment (if required) of minutes of previous monthly progress meeting

b. Review of progress since previous monthly progress meeting

c. Planned progress through next 30 to 60 days

d. Review of Progress Schedule

1) Contract Times, including Milestones (if any)

2) Critical path

3) Schedules for fabrication and delivery of materials and equipment

4) Corrective measures, if required

e. Submittals

1) Review of status of critical submittals

2) Review revisions to schedule of submittals

f. Contract Modifications

1) Requests for Interpretation

2) Field Orders

3) Requests for Proposal

4) Change Proposals

5) Work Change Directives

6) Change Orders

7) Claims

g. Applications for progress payments

h. Problems, conflicts, and observations

i. Quality standards, testing, and inspections

j. Coordination between parties

k. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues

l. Safety

m. Permits

n. Record documents status

o. Punch list status, as applicable

p. Other business

C. Weekly Progress Meetings

1. Weekly progress meetings frequency shall be conducted as specified in this Section, unless modified and agreed upon by Owner, Engineer, and Contractor. Additional meetings may be conducted as progress of Work requires.

2. Attendance

a. Contractor, including Project Manager, Site Superintendent, Safety Representative, and representatives of Subcontractors and Suppliers as required

b. Engineer's RPR and others as required by Engineer

c. Owner's plant personnel

3. Minimum Agenda

a. Review of progress since the previous weekly or monthly progress meeting

b. Planned progress through next 2 weeks

c. Coordination between parties

d. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues

e. Safety

## 1.03 SUBMITTALS

A. Pre-Construction Meeting Submittals

1. Prior to the Pre-Construction Meeting, submit the following preliminary schedules in accordance with the General Conditions:

1) Progress Schedule

2) Schedule of Submittals

3) Schedule of Values

2. Contractor's safety and first aid procedures

3. Confined space entry plan

4. List of emergency contact information

B. Monthly Progress Meeting Submittals

1. List of Work accomplished since the previous monthly progress meeting

2. Up-to-date Progress Schedule

3. Up-to-date Schedule of Submittals

4. Detailed “look-ahead” schedule of work planned through the next monthly 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

5. When applicable, list of upcoming planned time off (with dates) for personnel with significant roles on the Project and the designated contact person in their absence

## 1.04 EMERGENCY CONTACT INFORMATION

A. Contractor shall provide 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, provide updated emergency contact information list at the next progress meeting.

B. Contractor’s list of emergency contact information shall include:

1. Contractor’s Project Manager’s office, field office, cellular, and home telephone numbers

2. Contractor’s Site Superintendent’s office, field office, cellular, and home telephone numbers

3. Contractor’s Foreman’s field office, cellular, and home telephone numbers

4. Major Subcontractors’ and Suppliers’ office, cellular, and home telephone numbers of project manager and foreman (when applicable)

C. Additional Emergency Contact Information

1. Owner’s Project Manager: office, cellular, and home telephone numbers

2. Owner’s central 24-hour emergency telephone number

3. Engineer’s project engineer’s office, cellular, and home telephone numbers

4. Engineer’s RPR’s office, field office, cellular, and home telephone numbers

5. Emergency telephone numbers including: “Emergency: Dial 911” and names and 7-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site

6. Other involved entities as applicable

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 32 00
## CONSTRUCTION PROGRESS SCHEDULE

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall prepare and submit Progress Schedules and related documents for performance of the Work in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section, unless otherwise accepted by Engineer.

1. Contractor shall maintain and revise/update Progress Schedules and related documents.

2. Progress Schedule shall be a Critical Path Method (CPM) Progress Schedule.

B. This Section includes detailed requirements and/or procedures for the Preliminary Project Schedule, Project Schedule Updates, Project Schedule development, Time Impact Analysis, and Recovery Schedules.

C. Except as otherwise provided herein or elsewhere in the Contract Documents, the planning, scheduling, coordination, and execution of the Work shall be the sole responsibility of the Contractor.

D. Engineer's acceptance of the Progress Schedule or related documents, and associated comments or opinions concerning activities, shall not control independent judgment of Contractor concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. Contractor shall be solely responsible for complying with the Contract Times.

### 1.02 REFERENCES

A. Definitions

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 tie between Activities. The Contract Times are Constraints.

3. CPM Progress Schedule: Computerized Progress Schedule in CPM format which accounts for the entire Work, defines the interrelationships between elements of

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the Work, reflects the uncompleted items of the Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted items of the 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 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 (e.g., yard piping, a structure or building, a treatment process, or other logical grouping)

## 1.03 ADMINISTRATIVE REQUIREMENTS

A. Initial Progress Schedule

1. Type and Organization of Progress Schedules

a. Prepare one Progress Schedule covering the entire Project using scheduling software that is acceptable to Engineer.

b. Schedule submittals shall include the electronic native file format (i.e., scheduling software file), and an electronic file in Portable Document Format (.pdf) of the schedule’s logic diagram.

c. Sheet Size: 11” by 17”, unless otherwise accepted by Engineer

d. Time Scale: Indicate first date of each work week.

e. Activity Designations: Indicate title, concise description of the Work represented by the Activity, and related Specification Section number. The Work related to each Activity shall be limited to one work trade and one construction area.

2. Submitted .pdf files shall be in a Gantt Chart format and shall show the following:

a. Activity identification number

b. Activity description

c. Activity duration (in workdays)

d. Activity percent complete

e. Start, Early Start, Late Start, Finish, Early Finish, and Late Finish Dates

f. Total Float for each Activity

g. Critical Path denoted

3. 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 Specification Section number.

4. Preliminary Progress Schedule

a. Contractor shall submit to Engineer the Preliminary Progress Schedule with associated Network Diagrams within 30 calendar days after the Contract Times commence running.

b. Submit five hard copies and two electronic copies (file format as specified herein) of Preliminary Progress Schedule and associated reports and schedule-related documents to accompany the Preliminary Progress Schedule in accordance with Article 1.09 SUBMITTALS herein and Section 01 33 00 – Submittal Procedures.

5. Initial Acceptance of Progress Schedule

a. At least 10 days before submission of the first Application for Payment, Contractor shall schedule a conference at the Site for review of the Preliminary Progress Schedule.

1) Attendees shall include Contractor, Engineer, Owner, and others as required.

2) Contractor shall have an additional 10 days to make corrections and adjustments and complete and resubmit the Progress Schedule and associated Network Diagram.

3) Owner reserves the right to not make progress payment(s) to Contractor until acceptable Progress Schedule, Network Diagram and other reports and schedule-related documents required are submitted to Engineer.

b. Submit five hard copies and two electronic copies (file format as specified herein) of acceptable Progress Schedule with Network Diagram, reports and other schedule-related documents required to accompany the initial acceptable Progress Schedule in accordance with Article 1.09 SUBMITTALS herein and Section 01 33 00 – Submittal Procedures.

c. Initially accepted Progress Schedule shall be identified as the Baseline Progress Schedule.

B. Project Schedule Updates

1. Project Schedule Updates shall be prepared on a monthly basis throughout the entire Contract Time and until Project Final Completion. The Engineer will not recommend progress payments by the Owner until a complete Project Schedule Update (including Schedule Narrative Report) is received, reviewed, and accepted by the Engineer.

2. If, during progress of the Work, events develop that necessitate changes in the initially accepted Progress Schedule (i.e., Baseline Progress Schedule), identify updated Progress Schedules sequentially as Progress Schedule Revision 1, 2, 3, and continuing in sequence as required.

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 shall be identical to that required in this Section for initial Progress Schedules.

5. Submit to Engineer five hard copies and two electronic copies (file format as specified herein) of the updated Progress Schedule, Network Diagram, Schedule Narrative Report, and other schedule-related reports and documents required.

6. Submit updated Network Diagrams when revisions are proposed to the logic. Indicate in the Schedule 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.

7. Monthly Progress Schedule updates shall be accompanied by a Schedule Narrative Report. The report shall:

    a. Describe items of Work completed within the preceding month

    b. Describe items of Work planned for the following month (including a look-ahead schedule)

    c. Identify proposed changes or revisions to the Baseline Progress Schedule

    d. Identify all items of Work performed out of sequence

    e. Identify problem areas

    f. Identify current or anticipated conditions which may delay the Work

## 1.04 NETWORK DIAGRAMS (PERT CHARTS)

A. General

1. Contractor shall prepare and submit Network Diagrams, as generated using the scheduling software 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. 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 workdays)

d. Critical Path denoted

e. Float for each Activity

f. Activity or System designation

g. Coded Area designation

h. Responsibility code (e.g., Contractor and their respective Subcontractors, 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. Revisions

1. When conditions develop that require revisions to logic or durations of the Network Diagram associated with the initially accepted Progress Schedule (i.e., Baseline Progress Schedule), identify updates to the Network Diagram in the same manner required in this Section for Progress Schedule updates.

2. Revision of the logic or durations from the baseline Progress Schedule initially accepted by Engineer shall be submitted to Engineer for acceptance.

3. 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.

4. Changes resulting from Change Orders and other additions or deletions shall be fully incorporated into the Progress Schedule and Network Diagram on the first update after the associated Change Order is approved by Owner, including adjustments to the Contract Price.

## 1.05 PROJECT SCHEDULE DEVELOPMENT

A. The schedule shall cover the entire Contact Time, and the Work shall be scheduled to complete the Project within the Contract Time.

B. The Schedule's Late Finish Date shall equal the Contract Completion Date.

C. All activities except for the Notice to Proceed (NTP) and Final Completion shall have a predecessor and a successor. No open-ended activities are permitted. Note that NTP shall have a successor or successors and Final Completion shall have a predecessor or predecessors.

D. Proposed durations assigned to each activity shall be the Contractor's best estimate of time required to complete the activity, considering the scope and resources planned for the activity.

E. The durations of activities shall be expressed in whole working days, with a maximum duration of 20 workdays each, unless otherwise approved or directed by the Engineer or Owner. The duration of non-construction activities including mobilization, shop drawings and sample submittals, fabrication of materials and equipment, and delivery of materials and equipment may exceed this limitation.

F. The Schedule shall incorporate in detail all elements of the Work contained within the Contract Documents. Specific elements of the Work to incorporate into the schedule include but are not limited to the following:

1. NTP

2. Mobilization and demobilization

3. Submittals including Operation and Maintenance (O&M) Manuals. Note that durations for Engineer review time shall be 15 working days unless specified elsewhere in these Contract Documents.

4. Fabrication and procurement activities

5. Temporary construction activities and relocations

6. Permitting

7. Erosion and sedimentation control

8. Site clearing

9. Site restoration

10. All requirements for coordination with Owner's operations

11. Concrete curing and form removal

12. All testing activities

13. Inspections as required by local authorities

14. Interim Milestones as defined by this Contact or as deemed critical as the project progresses

15. All requirements related to facility startup and commissioning

16. Substantial Completion (including the period for performing the punchlist)

17. Final Completion

## 1.06 TIME IMPACT ANALYSIS

A. General

1. Prepare and submit a time impact analysis when one or more of the following occurs:

    a. Change Order proposal is prepared

    b. Work Change Directive is issued that will affect the Progress Schedule

    c. Delays are experienced

2. Time impact analysis shall illustrate the influence of each Change Order, Work Change Directive, or delay.

3. Each time impact analysis shall include a sketch (fragnet) demonstrating how Contractor proposes to incorporate the changes in the Project or, as applicable,

delays into the Progress Schedule. Fragnet shall include all logic and additions required as result of said Change Order, Work Change Directive, or delay.

4. Fragnet shall show all CPM logic revisions for the Work associated with the Change Order, Work Change Directive, or delay and its relationship to other Activities in the Network Diagram.

5. Timing of Time Impact Analysis

   a. Submit each time impact analysis within 7 calendar days after the following, as applicable:

      1) Start of the delay

      2) After the submittal of Change Order proposal to Engineer

      3) After Contractor's receipt of Work Change Directive

   b. Failure to Submit Time Impact Analysis: When Contractor does not submit time impact analysis for a specific change or delay under the Contract 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.

## 1.07 RECOVERY SCHEDULES

A. General

1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls 30 or more calendar 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 recovery Progress Schedule demonstrating Contractor's plan to accelerate the Project to achieve compliance with the Contract Times for Engineer's acceptance.

2. Submit recovery Progress Schedule within 14 calendar days after submittal of updated Progress Schedule where need for recovery is indicated.

B. Implementation of Recovery Schedule

1. At no additional cost to Owner, Contractor shall do one or more of the following:

a. Furnish additional labor and construction equipment.

b. Employ additional work shifts.

c. Expedite procurement of materials and equipment to be incorporated into the Work.

d. Other measures necessary to complete the Work within the Contract Times.

2. Upon acceptance of recovery Progress Schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action: Contractor's refusal, failure or neglect to submit a recovery Progress 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

## 1.08 USE OF FLOAT

A. Total Float and Contract Float belong to the Project and may be used by Owner, Engineer, or Contractor to accommodate modifications, regardless of origination, in the Work or to mitigate the effect of events that may delay performance or completion of the Work.

B. Changes or delays that influence scheduled Work Activities with Float and that do not extend the Critical Path will not be justification for an extension in Contract Times.

## 1.09 SUBMITTALS

A. Action/Informational Submittals

1. Initial Progress Schedules

a. Preliminary Progress Schedule with associated Network Diagrams

b. Acceptable Progress Schedule with associated Network Diagrams

2. Progress Schedule Updates

a. Progress Schedule updates shall comply with requirements of this Section and shall include updated Progress Schedule and updated Network Diagram

when relationships among Activities have changed and Schedule Narrative Report.

b. Submit updated Progress Schedule at each monthly progress meeting. If a Progress Schedule remains unchanged from one monthly progress meeting to the next, submit a written statement to that effect.

3. Time Impact Analyses: Submit in accordance with this Section.

4. Recovery Progress Schedule: Submit in accordance with this Section.

5. Qualifications: Progress Schedule preparer and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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# SECTION 01 33 00
# SUBMITTAL PROCEDURES

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section includes:

1. Contractor shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions and this Section.

2. Contractor shall be responsible for confirming and correcting dimensions at the Site, for information pertaining to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. Contractor's signature of submittal's stamp and letter of transmittal shall be Contractor's representation that Contractor has met their obligations under the Contract Documents relative to that submittal.

B. Related Sections

1. Section 01 25 00 – Substitution Procedures

2. Section 01 78 23 – Operation and Maintenance Data

3. Section 01 78 39 – Project Record Documents

4. Section 01 78 43 – Spare Parts and Extra Material

5. Section 01 79 00 – Instruction of Owner's Personnel

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Types of Submittals: When type of submittal is not specified and is not specified in this Section, Engineer will determine type of submittal.

1. Action/Informational Submittals

a. Shop drawings

b. Product data

c. Delegated design submittals in accordance with the General Conditions and as modified by the Supplemental Conditions

d. Samples

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e. Testing plans, procedures, and testing limitations

f. Design data not sealed and signed by a design professional retained by Contractor, Subcontractor, or Supplier

g. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Conditions, and similar reports

h. Supplier instructions, including installation data, and instructions for handling, startup, and troubleshooting

i. Sustainable design submittals (other than sustainable design closeout documentation)

j. Lesson plans for training and instruction of Owner's personnel

2. Closeout Submittals

a. Maintenance contracts

b. Operations and maintenance data

c. Bonds, such as maintenance bonds and bonds for a specific product or system

d. Warranty documentation

e. Record documentation

f. Sustainable design closeout documentation

g. Software

3. Maintenance Material Submittals

a. Maintenance materials schedule and checklist

b. Spare parts

c. Extra stock materials

d. Tools

4. Quality Assurance Submittals

a. Performance affidavits

b. Certificates

c. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing

d. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site

e. Supplier reports

f. Special procedure submittals, including health and safety plans and other procedural submittals

g. Qualifications statements

B. Submittal Requirements

1. Contractor shall submit electronic copy of submittals for Engineer's review via Autodesk Construction Cloud Build (ACC Build), unless otherwise specified in individual Specification Sections.

   a. Acceptable electronic file formats are Portable Document Format (i.e., .pdf), Microsoft Word .docx, Autodesk .dwf, and AutoCAD .dwg. If Microsoft Word .docx, Autodesk .dwf, or AutoCAD .dwg files are submitted, corresponding .pdf files of the same information, drawing, image, etc. shall also be submitted

2. Submittal shall be accompanied by letter of transmittal containing date, Project title, Contractor's name, number and title of submittal, relevant Specification Section(s), notification of deviations from Contract Documents, and other material required for Engineer's review.

3. Submittals with internet hyperlinks and other references to online content shall not be included as part of the submittal review procedure and will not be considered or reviewed. Hyperlinks and other electronic references shall not be used to comply with specified requirements of the Contract Documents, unless specifically stated in the individual technical Specification Section.

4. Electronic Submittal File Format Requirements

   a. Files shall be completely electronically searchable for details of submitted equipment and/or material.

b. Provide bookmarks within files in excess of 20 pages for submitted equipment and material including, but not limited to, the following:

1) Each chapter and subsection listed in the file's table of contents

2) Each figure, table, and appendix

3) Each drawing

c. Electronic submittal files shall be named and numbered using a "## ## ##-##.## Xxxxx" format where "## ## ##" is the Specification Section number, the first "##" is the sequential submittal number under each individual Specification Section, the second "##" is the revision number, and "Xxxxx" is a concise but detailed description of the submittal contents (i.e., submittal "03 21 00-03.02 Reinforcing Steel for Drain Pump Station Structure" would be the second revision (first resubmittal) for the reinforcing steel for the drain pump station structure and the third submittal for reinforcing steel under Section 03 21 00 – Reinforcing Steel).

C. Scheduling

1. Provide submittals well in advance of the need for the material, equipment, or procedure (as applicable) in the Work, with ample time required for delivery of material or equipment, and to implement review comments following Engineer's approval or acceptance of the associated submittal. Work covered by a submittal shall not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.

2. Submittals shall be provided by Contractor with at least 15 working days for review and processing.

## 1.03 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals

1. Timing

a. Provide submittal within time frames specified in the Contract Documents.

b. Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.

2. Content: In accordance with the General Conditions as 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.

a. Identify 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.

b. Indicate the following for each submittal:

1) Date when submittals are requested and received from Supplier

2) Date when certification is received from Supplier and when submitted to Engineer

3) Date when submittals are submitted to Engineer and returned with disposition from Engineer

4) Date when submittals are revised by Supplier and submitted to Engineer

5) Date when submittals are returned with "Furnish as Submitted" (FAS) or "Furnish as Corrected" (FAC) disposition from Engineer

6) Date when approved submittals are returned to Supplier

7) Date of Supplier's scheduled delivery of equipment and/or material

8) Date of actual delivery of equipment and/or material

9) Whether submittal will be for a substitution or "or equal". Procedures for substitutions and "or equals" are specified in the General Conditions and Section 01 25 00 – Substitution Procedures.

10) 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

3. Prepare Schedule of Submittals using same software and in same format specified for Progress Schedules.

4. Coordinate Schedule of Submittals with the Progress Schedule.

5. Schedule of Submittals that is not compatible with the Progress Schedule, does not indicate submittals on the Project's critical path, or places extraordinary demands on Engineer for time and resources is unacceptable. Do not include submittals not required by the Contract Documents.

6. In preparing Schedule of Submittals:

    a. Considering the nature and complexity of each submittal, allow sufficient time for review and revision.

    b. 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.

    c. Identify and accordingly schedule submittals that are expected to have long anticipated review times.

## 1.04 ACTION/INFORMATIONAL SUBMITTALS

A. Provide the following submittals in accordance with the individual Specification Sections including, but not limited to, the following:

1. Product Data

    a. Catalog cutsheets (i.e., manufacturer's literature)

    b. Descriptive bulletins/brochures/specifications

    c. Material of construction data including details on all components and applicable ASTM designations

    d. Lifting, erection, installation, and adjustment instructions and recommendations

    e. Finish/treatment data including interior and exterior shop coating systems

    f. Equipment/material weight/loading data including total uncrated weight of the equipment plus the approximate weight of shipped materials, support locations and loads that will be transmitted to bases and foundations following installation, and size, placement, and embedment requirements of anchor bolts

    g. Complete information regarding location, type, size, and length of all field welds in accordance with AWS A2.0. Special conditions shall be fully explained by notes and details.

    h. Motor data including horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service rating; rotative speed; motor speed-torque relationship; efficiency and power factor at 1/2, 3/4, and full load; slip at full load; running, full load, and locked rotor current values; safe running time-current curves; motor protective devices; and interconnection diagrams

i. Engineering design data, calculations, and system analyses

j. Digital system documentation

k. Operating sequence descriptions

l. Software/programming documentation

m. Manufacturer's instructions

2. Shop Drawings

a. Equipment and material layout drawings, including panel layout drawings

b. System schematics and diagrams including, but not limited to, piping systems; HVAC and ventilation systems; process equipment systems; electrical operating systems; wiring diagrams; and controls, alarm and communication systems

c. Layout and installation drawings (interior and exterior) for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc.

d. Layout and installation drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.

e. Drawings shall show the locations and types of all supports, hangers, foundations, etc. and the required clearances to operate valves, equipment, etc.

f. Drawings for pipes, ducts, conduits, etc., shall show all 3-inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structures, manholes or any other feature within 4 feet (measured as the clear dimension) from the pipe duct, conduit, etc. for which the profile is drawn.

g. Equipment and material schedules

3. 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 Specification Section. Delegated design submittals include design drawings, design data including

calculations, specifications, certifications, and other submittals prepared by such design professional.

B. Samples

1. General Requirements

a. Conform submittal of samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section(s) in which the sample is specified.

b. Furnish at the same time samples and submittals that are related to the same unit of Work or Specification Section. Engineer will not review submittals without associated samples and will not review samples without associated submittals.

c. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

2. Submittal Requirements

a. Securely label or tag samples with submittal identification number. 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 number of samples required in Specification Section(s). If number of samples is not specified in the associated Specification Section, provide at least one identical sample of each item required for Engineer's approval. If Contractor requires sample(s) for Contractor's use, notify Engineer in writing and provide additional sample(s). Contractor shall be 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 location directed by Engineer.

## 1.05 CLOSEOUT SUBMITTALS

A. Provide the following closeout submittals in accordance with the individual Specification Sections including, but not limited to, the following:

1. Maintenance contracts

2. Bonds for specific products or systems

3. Warranty documentation

4. Sustainable design closeout documentation

5. Software programming and documentation

B. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.

C. Operation and Maintenance Data: Submit in accordance with Section 01 78 23 – Operation and Maintenance Data.

D. Record Documentation: Submit in accordance with Section 01 78 39 – Project Record Documents.

E. Disposition: Dispositions and meanings shall be the same as specified for informational submittals.

## 1.06 MAINTENANCE MATERIAL SUBMITTALS

A. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section. Furnish in accordance with Section 01 78 43 – Spare Parts and Extra Material.

B. Disposition: Dispositions and meanings shall be the same as specified for informational submittals.

## 1.07 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall review, coordinate, and verify submittals with Subcontractors, Manufacturers, and Suppliers, including field measurements at Site, in accordance with the General Conditions and as modified by Supplemental Conditions prior to submitting material for Engineer's review.

B. Contractor shall clearly and concisely indicate and mark equipment and material being submitted to meet the intent of the Contract Documents. Equipment and material not being submitted shall be deleted, stricken through, or otherwise designated not being submitted. Equipment and material data sheets shall be included once with cross-references throughout the submittal. Multiple equipment and material data sheets for the same item within a submittal may receive a rejected disposition until corrected.

1. Individual Specification Sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be included with the submittal. When specified, submittals provided without the CD&E letter shall receive a rejected disposition without review.

2. CD&E Letter Requirements

a. Include a copy of entire Specification Section with each paragraph and subparagraph noted with "C", "D", or "E" to indicate if equipment and material

being provided is in compliance (C), deviates (D), or exceptions (E) are taken with the Contract Documents.

1) Compliance (C): Full compliance with the specified requirement

2) Deviation (D): Deviation from the specified requirement

3) Exception (E): Exception with the specified requirement

b. Include all comments, deviations and exceptions taken to the Contract Documents by the Contractor and Equipment Manufacturer/Supplier.

c. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable.

d. Address deviations and exceptions taken to each Drawing related to the Specification Section.

C. Contractor shall provide Contractor’s stamp of approval certifying submittal material has been reviewed and conforms to the Contract Documents prior to submitting material for Engineer’s review.

D. Contractor shall provide written notice of deviations or variations that submittal may have with the Contract Documents.

E. Contractor shall provide bound, dated, labeled, tabulated, and consecutively numbered submittals as specified in the individual Specification Section. Label shall contain the following:

1. Specification Section

2. Referenced Drawing number

3. Subcontractor or Supplier name

4. Type of equipment and/or materials

F. Contractor shall perform the following after receiving Engineer’s review disposition:

1. Order, fabricate, or ship equipment and materials included in the submittal (pending Engineer’s review of source quality control submittals) with the following disposition:

a. “Furnish as Submitted” (FAS)

b. “Furnish as Corrected” (FAC)

c. “Furnish as Corrected – Confirm” (FACC), only portions of Work that do not require resubmittal for Engineer’s review

2. Resubmittal Requirements

a. Partial resubmittal of “Furnish as Corrected – Confirm” (FACC) returned dispositions, until Engineer’s disposition is either “Furnish as Submitted” (FAS) or “Furnish as Corrected” (FAC)

b. Full resubmittal of material with Engineer’s disposition of “Revise and Resubmit” (R&R), until Engineer’s disposition is “Furnish as Submitted” (FAS), “Furnish as Corrected” (FAC), or “Furnish as Corrected – Confirm” (FACC) that requires a partial resubmittal

c. Contractor shall be responsible for Engineer’s charges to Owner if submittals are not approved within the number of specified submittals in accordance with the General Conditions and Supplementary Conditions. Engineer’s charges shall include, but not be limited to, additional review effort, meetings, and conference calls with Contractor, Subcontractor, and/or Supplier.

## 1.08 ENGINEER’S REVIEW

A. Engineer’s review of the Contractor’s submittal shall not relieve Contractor’s responsibility under the Contract Documents in accordance with the General Conditions and as modified in the Supplemental Conditions. An acceptance of a submittal shall be intended to mean the Engineer does not have specific objection to the submitted material, subject to conformance with the Drawings and Specifications.

B. Engineer’s review of Contractor’s submittal shall be confined to general arrangement and compliance with the Contract Documents and shall not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of Subcontractor work, etc.

C. Review Dispositions

1. “Furnish as Submitted” (FAS): No exceptions are taken.

2. “Furnish as Corrected” (FAC): Minor corrections are noted for Contractor’s correction.

3. “Furnish as Corrected – Confirm” (FACC): Corrections are noted, and partial resubmittal shall be made as noted.

4. “Revise and Resubmit” (R&R): Corrections are noted and complete resubmittal shall be made. Submittal does not conform to applicable requirements of the

Contract Documents and is not acceptable. Revise submittal and resubmit to indicate acceptability and conformance with the Contract Documents.

5. “Receipt Acknowledged” (RA)

    a. Information included in submittal conforms to the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to this submittal, the work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.

    b. Information included in submittal is for Project record purposes and does not require Engineer’s review or approval.

6. “Rejected” (R): Information included in submittal does not conform to the applicable requirements of the Contract Documents and is unacceptable. Contractor shall submit products and materials as specified in the Contract Documents or provide required information for substitution as specified in the Contract Documents for consideration by Engineer.

D. Electronic Submittal Return to Contractor: Electronic submittals shall be returned electronically with dispositions provided.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 35 20
## CONFINED SPACE ENTRY PLAN

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Owner has determined that portions of the Site may constitute confined spaces or permit-required confined spaces as defined in this Section.

B. Contractor shall provide appropriate measures including labor, supervision, equipment, protective devices, and incidentals to protect the health and safety of personnel at the Site relative to confined spaces and who may be affected by the Work in confined spaces including, without limitation: employees and agents of Contractor, Subcontractors, Suppliers, Owner, and Engineer while engaged in performance of their respective duties at Site.

C. Comply with requirements of Owner's confined space entry program, if any.

### 1.02 REFERENCES

A. Definitions: The following words or terms are not defined but, when used in this Section, have the following meaning:

1. "Confined spaces" are areas on or about the Site as defined in 29 CFR (Code of Federal Regulations) 1910.146(b) and 29 CFR 1926.1202. Confined spaces include, but are not limited to: storage tanks, process vessels, bins, boilers and similar spaces; ventilation or exhaust ducts and stacks; manholes, underground utility vaults and chambers, sewers, pipelines, tunnels; and open-topped spaces greater than 4 feet deep, such as pits, tubs, vaults, and vessels.

2. "Entry permit" means the written or printed document provided by the employer of personnel entering permit-required confined space to allow and control entry into permit-required confined space and that contains the information specified in 29 CFR 1910.146(f) and 29 CFR 1926.1206.

3. "Permit-required confined space" means confined space as defined in 29 CFR 1926.146(b) and 29 CFR 1926.1202 and that has one or more of the following characteristics:

    a. Contains or has potential to contain a hazardous atmosphere

    b. Contains material that has potential for engulfing an entrant

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c. Has internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or floors or by floor that slopes downward and tapers to a smaller cross-section

d. Contains other recognized serious safety or health hazard

4. “Hot work permit” means the written authorization of employer of personnel entering a confined space to perform operations, such as riveting, welding, cutting, burning, and heating, capable of providing a source of ignition.

5. “Host employer” means the employer that owns or manages the property where construction is taking place.

6. “Controlling contractor” is the employer that has overall responsibility for construction at the worksite.

B. Reference Standards: Comply with Laws and Regulations related to protecting personnel working in or entering confined spaces, including:

1. CFR, Title 29, Part 1910, Occupational Safety and Health Standards

2. CFR, Title 29, Part 1926, Safety and Health Regulations for Construction

## 1.03 PLAN REQUIREMENTS

A. Review host employer’s existing confined space inventory and entry procedures, if available, in order to prepare Site- and task-specific confined space entry plans which shall be incorporated into Contractor’s Site-specific health and safety plan. Maintain copy of the confined space entry plan at the Site for access by employees, Owner and authorities having jurisdiction. Confined space entry plan shall include:

1. Results of Contractor’s Site-specific hazard assessment to identify confined spaces that are permit-required confined spaces, including list of all such spaces that will be accessed for the Work. Update the list as required throughout the Project.

2. Requirements for safeguarding access to, and restricting non-permitted personnel from access to, permit-required confined spaces during the Work

3. Project-specific procedures to be followed when entering or accessing permit-required confined spaces

4. Documentation of training provided to each person that will enter, or work in conjunction with entry to, permit-required confined spaces

5. Update the plan by adding copies of permits issued and records of entry to permit-required confined spaces, as required in this Section.

B. Confined Space Safety

1. Personnel entering confined space shall be trained in accordance with 29 CFR 1926.1207 and 29 CFR 1910.146(g).

2. Comply with 29 CFR 1926 Subpart AA and requirements of authorities having jurisdiction.

3. Recordkeeping: Using forms required by Contractor, Owner, or authority having jurisdiction, issue for each instance of access to permit-required confined space, completed permit(s) and complete associated data sheet. File completed permits and data sheets in the Site-specific confined space entry plan and submit in accordance with this Section.

a. Permit for entry to permit-required confined space(s)

b. Permit for hot work in permit-required confined space(s)

c. Complete confined space data sheet

## 1.04 SUBMITTALS

A. If acceptable, written response for submittals required in this Section will not be returned to Contractor.

B. Submit the following to Owner; if submittals under this Section are furnished to Engineer, Engineer will forward all submittals under this Section to Owner without review.

1. Procedures: Site-specific confined space entry plan, submitted upon request of Owner

2. Permits and Reports: For each time personnel enter a confined space, copies of completed permits required for confined space entry and completed confined space data sheets submitted upon request of Owner

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

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## SECTION 01 42 00
## REFERENCES

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions and Supplementary Conditions.

### 1.02 REFERENCES

A. Abbreviations and Acronyms: Common abbreviations that may be found in the Contract Documents are listed below:

| | |
|---|---|
| alternating current | a-c |
| ampere | A |
| Architectural Barriers Act | ABA |
| Americans with Disabilities Act | ADA |
| Americans with Disabilities Act Accessibility Guidelines | ADAAG |
| ante meridian | a.m. |
| average | avg |
| biochemical oxygen demand | BOD |
| brake horsepower | bhp |
| British thermal unit | Btu |
| Centigrade (or Celsius) | C |
| chlorinated polyvinyl chloride | CPVC |
| Code of Federal Regulations | CFR |
| cubic inch | cu in |
| cubic foot | cu ft |
| cubic yard | cdu yd, or CY |
| cubic feet per minute | cfm |
| cubic feet per second | cfs |

| | |
|---|---|
| degree Centigrade (or Celsius) | degrees C or ºC |
| degrees Fahrenheit | degrees F or ºF |
| diameter | dia |
| direct current | d-c |
| dollars | $ |
| each | ea |
| efficiency | eff |
| Fahrenheit | F |
| feet | ft |
| feet per hour | fph |
| feet per minute | fpm |
| feet per second | fps |
| figure | Fig |
| flange | flg |
| foot-pound | ft-lb |
| gallon | gal |
| gallons per hour | gph |
| 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 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 |
| linear foot | lin ft or LF |
| liter | L |
| maximum | max |
| mercury | Hg |
| milligram | mg |
| milligrams per liter | mg/l or mg/L |
| milliliter | ml |
| millimeter | mm |
| million gallons per day | mgd |
| million gallons | MG |
| minimum | min |
| national pipe threads | NPT |
| net positive suction head | NPSH |
| net positive suction head available | NPSHA |
| net positive suction head required | NPSHR |
| 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 or SF |
| square inch | sq in |
| square yard | sq yd or SY |
| standard | std |
| standard cubic feet per minute | scfm |
| total dynamic head | TDH |
| water column | w.c. |
| water gage | w.g. |

B. Definitions: Terminology used in the Specifications includes:

1. “Indicated” refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the Contract Documents.

2. “Shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference without limitation on the location.

3. “Installer”, “applicator”, or “erector” is Contractor or another 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.

4. “Experienced”, when used with the term “installer” means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; 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.

5. Trades: Use of a term 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.

6. “Assigned specialists” and similar terms: Certain Sections of the Specifications require that specific construction activities be performed by specialists recognized as experts in those operations. Engage said specialists for those activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Also, such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.

C. Reference Standards

1. Refer to General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.

2. 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.

3. 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.

4. Following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

| | |
|---|---|
| AA | Aluminum Association |
| AABC | Associated Air Balance Council |
| AAMA | American Architectural Manufacturers Association |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |
| ACIFS | American Cast Iron Flange Standards |
| ACPA | American Concrete Pipe Association |
| ACS | American Chemical Society |
| ADC | Air Diffusion Council |
| ADSC | International Association of Foundation Drilling |
| AEIC | Association of Edison Illuminating Companies |
| AF&PA | American Forest and Paper Association |
| ABMA | American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (ABMA)) |
| AGA | American Gas Association |
| AGMA | American Gear Manufacturers Association |
| AHDGA | American Hot Dip Galvanizers Association |
| AI | Asphalt Institute |
| AIA | American Institute of Architects |
| AIChE | American Institute of Chemical Engineers |
| AISC | American Institute of Steel Construction |
| AISI | American Iron and Steel Institute |
| AITC | American Institute of Timber Construction |

| | |
|---|---|
| ALSC | American Lumber Standards Committee |
| AMA | Acoustical Materials Association |
| AMCA | Air Movement and Control Association |
| AMP | National Association of Architectural Metal Manufacturers, Architectural Metal Products Division |
| ANSI | American National Standards Institute |
| APA | The Engineered Wood Association |
| API | American Petroleum Institute |
| APHA | American Public Health Association |
| AREA | American Railway Engineering Association |
| ARI | Air Conditioning and Refrigeration Institute |
| ASA | American Standards Association |
| 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 |

| | |
|---|---|
| BOCA | Building Officials and Code Administrators |
| CBMA | Certified Ballast Manufacturers Association |
| CCWSA | Cherokee County Water & Sewerage Authority |
| 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 |
| CPSC | Consumer Product Safety Commission |
| CRSI | Concrete Reinforcing Steel Institute |
| CSI | Construction Specifications Institute |
| DIN | Deutsches Institut fur Normung eV (German Institute for Standardization) |
| DIPRA | Ductile Iron Pipe Research Association |
| EASA | Electrical Apparatus Service Association, Inc. |
| 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 |
| GA EPD | Georgia Environmental Protection Division |

| | |
|---|---|
| GA DNR | Georgia Department of Natural Resources |
| GANA | Glass Association of North America |
| GDOT | Georgia Department of Transportation |
| GSWCC | Georgia Soil and Water Conservation Commission |
| 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 |
| ICC-ES | ICC-Evaluation Service, LLC |
| ICEA | Insulated Cable Engineers Association |
| ICRI | International Concrete Repair Institute |
| IEEE | Institute of Electrical and Electronics Engineers |
| IESNA | Illuminating Engineering Society of North America |
| IFI | Industrial Fasteners Institute |
| IFCEA | Insulated Power Cable Engineers Association |
| IOS | International Organization for Standardization |
| IRI | Industrial Risk Insurers |
| ISA | Instrumentation, Systems, and Automation Society (formerly Instrument Society of America) |
| ISO | Insurance Services Office |
| LPI | Lightning Protection Institute |
| MBMA | Metal Building Manufacturers Association |
| 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 |
| NEBB | National Environmental Balancing Bureau |
| NEC | National Electrical 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 |
| PDI | Plumbing and Drainage Institute |
| PFI | Pipe Fabrication Institute |
| PPI | Plastics Pipe Institute |
| PGMC | Primary Glass Manufacturers Council |
| PS | Product Standards Section, United States Department of Commerce |
| RCSC | Research Council on Structural Connections (part of AISC) |
| RMA | Rubber Manufacturers Association |
| SAE | Society of Automotive Engineers |
| SBCCI | Southern Building Code Congress International, Inc. |
| 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 |
| TABB | Testing, Adjusting, and Balancing Bureau |
| TCNA | Tile Council of North America |
| TEMA | Tubular Exchanger Manufacturers Association |
| TIA/EIA | Telecommunications Industry Association/Electronic Industries Alliance |
| UBC | Uniform Building Code |
| 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 |
| WWEMA | Water and Wastewater Equipment Manufacturers Association |
| WWPA | Western Wood Products Association |

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01 45 23**

**TESTING SERVICES FURNISHED BY CONTRACTOR**

## PART 1 – GENERAL

### 1.01 SUMMARY

A. This Section addresses requirements for additional testing services specifically required to be provided by the Contractor. This Section does not apply to any testing required to be provided by the Owner or Owner's representative per Section 00 72 00 – General Conditions and the rest of the Specifications.

B. Initial testing required by the Specifications will typically be performed by a representative of the Owner unless otherwise indicated in the Specifications. The intent of this Section is to describe general requirements that apply to additional testing services, including retesting, to be performed by the Contractor in the event of nonconformance, noncompliance, etc. determined from the initial testing of materials, etc. by the Owner's representative.

C. This Section does not apply to any Special Inspections as required by Section 01 45 33 – Special Inspections. Special Inspections cannot be provided by the Contractor in accordance with the Governing Building Code.

D. Contractor shall employ and pay for an independent testing entity to perform services specified in this Section and other applicable Sections of the Specifications. Entity selected shall be subject to approval by Engineer.

E. Inspection, sampling, and testing shall be as specified in the individual Specification Sections.

F. Whenever nonconformance is determined by Engineer as a result of such tests, inspections, or investigations, the Contractor shall bear the full cost of any additional tests, inspections, and investigations ordered by the Owner or Engineer to ascertain subsequent conformance with the Contract Documents.

G. Materials for additional testing may include, but not be limited to, the following and as specified in the individual Specification Sections:

1. Cement/concrete

2. Bituminous paving materials

3. Select backfill

4. Epoxy anchorage

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H. Testing Laboratory Services

1. Initial laboratory testing and checking required by the Specifications, including the cost of transporting all samples and test specimens, will typically be provided and paid for by the Owner unless otherwise indicated in the Specifications.

2. Tests required by the Owner shall not relieve the Contractor from the responsibility of supplying test results and certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.

3. Procedure

   a. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens as required and to allow adequate time for laboratory tests.

   b. The collection, field preparation, and storage of field samples and test specimens shall be as directed by the Engineer's Resident Project Representative (RPR) and Engineer with the cooperation of the Contractor.

4. Significance of Tests: Test results shall be binding on both the Contractor and the Owner and shall be considered irrefutable evidence of compliance or non-compliance with the requirements of the Specifications, unless supplementary testing proves, to the satisfaction of the Owner, that the initial samples were not representative of actual conditions.

5. Supplementary and Other Testing: Nothing shall restrict the Contractor from conducting tests they may require. Should the Contractor at any time request the Owner to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the Owner. Testing of this nature shall be conducted at the Contractor's expense.

## 1.02 WATERTIGHTNESS OF STRUCTURES

A. Concrete structure testing shall be performed by the Contractor in accordance with Section 01 88 16 – Watertightness Testing of Concrete Structures.

B. It is the intent of these Specifications that all concrete work, sealing work around built-in items, and penetrations be performed as required to ensure that groundwater and water or liquids in tanks, channels, and containers will not intrude into any equipment rooms, pipe galleries, habitable areas, or other generally dry areas.

C. The required watertightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.

## 1.03 RELATED SECTIONS

A. Related Sections include, but are not limited to, the following:

1. Section 01 45 33 – Special Inspections
2. Section 01 88 16 – Watertightness Testing of Concrete Structures
3. Section 03 21 00 – Reinforcing Steel
4. Section 03 30 00 – Cast-in-Place Concrete
5. Section 04 05 13 – Mortar and Masonry Grout
6. Section 31 00 01 – Earthwork
7. Section 31 05 16 – Aggregate Materials
8. Section 31 23 24 – Flowable Fill
9. Section 32 10 00 – Paving and Surfacing
10. Section 33 05 61 – Utility Structures

## 1.04 IMPERFECT WORK OR MATERIALS

A. Any defective or imperfect work or materials furnished by the Contractor which are discovered before Final Acceptance of the work, as established by the Certificate of Substantial Completion, or during the subsequent guarantee period shall be immediately removed even though it may have been overlooked by the Owner and estimated for payment. Any work or materials condemned or rejected by the Owner shall be tagged as such and shall be immediately removed from the site. Satisfactory work or materials shall be substituted for that rejected.

B. The Owner may order tests of imperfect or damaged work or materials to determine the required functional capability for possible acceptance if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor, and the nature, tester, extent and supervision of the tests will be as determined by the Engineer's RPR and Owner. If the results of the tests indicate that the required functional capability of the work or material was not impaired, consistent with the final general appearance of same, the work or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work or materials has been impaired, then such work or materials shall be deemed imperfect and shall be replaced. The Contractor may elect to replace the imperfect work or material in lieu of performing the tests.

## 1.05 INSPECTION AND TESTS

A. The Contractor shall allow the Owner ample time and opportunity for testing materials and equipment to be used in the Work. The Contractor shall advise the Owner promptly upon placing orders for material so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture. The Contractor shall at all times furnish the Owner and their representatives facilities, including labor, and allow proper time for inspecting and testing materials and workmanship. The Contractor must anticipate possible delays that may be caused in the execution of the Work due to the necessity of materials being inspected and accepted for use.

B. Where other tests or analyses are specifically required in other Sections of these Specifications, the cost thereof shall be borne by the party (Owner or Contractor) so designated in such Sections. The Owner will bear the cost of all tests, inspections, or investigations undertaken by the order of the Engineer's RPR for the purpose of determining conformance with the Contract Documents if such tests, inspections, or investigations are not specifically required by the Contract Documents and if conformance is ascertained thereby. Whenever non-conformance is determined by the Engineer's RPR as a result of such tests, inspections, or investigations, the Contractor shall bear the full cost thereof or shall reimburse the Owner for said cost. In this connection, the cost of any additional tests and investigations which are ordered by the Engineer's RPR to ascertain subsequent conformance with the Contract Documents shall be borne by the Contractor.

C. During construction, the Engineer's RPR will be responsible for coordinating the Work with the Contractor and overseeing/witnessing the performance of the Work including, but not limited to, flow diversions, shutdowns, testing, and any additional work that may be required or determined to be necessary by the Owner. Should existing conditions necessitate a change in the Contract Documents, whether or not the change requires additional time or costs, the Contractor shall notify the Engineer's RPR, who will obtain approval of the change from the Owner's project manager prior to instructing the Contractor to proceed.

D. The Engineer's RPR will review and approve the Work or portions thereof completed by the Contractor prior to submittal for payment to the Owner. Failure to obtain prior approval may result in delays in processing payments

## 1.06 ADMINISTRATIVE REQUIREMENTS

A. Contractor's Responsibilities

1. Plan and conduct operations to permit taking of field samples and test specimens, as required, and allow adequate time for laboratory tests.

2. Provide samples of materials to be tested, in required quantities, to laboratory representative.

3. Provide labor and facilities:

    a. To provide access to the items of Work to be tested and Suppliers' operations where required.

    b. To obtain and handle samples at the Site, collect, field prepare, and store field samples and test specimens as directed by the Engineer, Engineer's RPR, and Owner.

    c. To facilitate inspections and tests.

    d. For testing entity's exclusive use for storage and curing of test samples.

    e. For forms for preparing concrete test beams and cylinders.

4. Notify testing entity and Engineer sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.

5. Arrange with testing entity and pay for additional services, sampling, and testing required for Contractor's convenience.

6. Provide to testing entity the preliminary design mix proposed for concrete and other material mixes that require testing by the testing laboratory.

B. Testing Entity's Responsibilities

1. Cooperate with Contractor and Engineer and provide qualified personnel promptly when notified.

2. Perform specified inspections, sampling, and testing of materials and methods of construction; comply with applicable standards; and ascertain compliance with requirements of the Contract Documents.

3. Promptly notify Engineer and Contractor of irregularities or deficiencies in the Work observed during performance of services.

4. Submit specified quantity of report copies of inspections and tests to Contractor and Engineer.

5. Perform additional tests and services as required to ensure compliance with the Contract Documents.

C. Report Requirements

1. Electronic submittal of testing reports via email

2. Include the following information:

    a. Date issued

    b. Project title, number, and name of the Site

    c. Testing laboratory name and address

    d. Name and signature of inspector or person obtaining samples

    e. Date of inspection or sampling

    f. Record of temperature and weather

    g. Date of test

    h. Identification of material or product tested and associated Specification Section

    i. Location at the Site

    j. Type of inspection or test

    k. Results of tests and observations regarding compliance with the Contract Documents.

## 1.07 SUBMITTALS

A. Submit copies of material and product test reports where required by the Contract Documents and as requested by Engineer.

B. Quality Assurance Submittals

1. Qualifications statement indicating experience and facilities for tests required under the Contract Documents

2. Copy of report of inspection of facilities during most recent NIST inspection tour, including memorandum of remedies of deficiencies reported during inspection

3. Copy of certificate of calibration for each instrument or measuring device proposed for use by accredited calibration agency

## 1.08 QUALIFICATIONS

A. Comply with applicable requirements of ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Laboratory shall be authorized to operate in the state of Georgia. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.

C. Testing equipment used by laboratory shall be calibrated at maximum 12-month intervals by devices of accuracy traceable to either NIST's Standard Reference Materials (SRM), ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories, or certified by state of Georgia or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 01 45 33
## SPECIAL INSPECTIONS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. This Section defines the requirements for Special Inspections as required by Section 1704 of the International Building Code (IBC) and any State or local amendments.

B. Either the Engineer of Record (EOR) or Registered Design Professional in Responsible Charge (RDPIRC) will prepare a Statement of Special Inspections, which identifies the type and extent of required Special Inspections.

C. The Owner will retain one or more Special Inspections Agencies to perform Special Inspection services. These Agencies shall be independent from the Contractor and approved by the Building Official. The EOR may perform Special Inspection services where qualifications for a specific inspection task are met.

D. The Contractor shall plan and conduct operations as to schedule and allow Special Inspections, providing adequate time and safe access for inspections. The Contractor shall coordinate requirements for Special Inspections with the Special Inspections Agency.

E. Special Inspections shall be in addition to inspections performed by Building Officials that are specified in IBC Section 104.

F. Special Inspections shall be in addition to any Structural Observations required by IBC Section 1704.6.

G. Special Inspections do not supersede other inspections and testing required by the Contract Documents to satisfy the Contractor’s quality control responsibility. Contractor shall be responsible for all costs associated with quality control requirements as required by other Sections of the Specifications.

H. Special Inspections shall not relieve Contractor’s obligation to perform and complete work in accordance with Contract Documents. Results of Special Inspections activities, including any discrepancies that are noted or not noted, shall never constitute an acceptance of work that is not in accordance with the Contract Documents.

I. This Section does not apply to construction equipment, shoring, earth retention systems, and temporary structures used by the Contractor in construction and not detailed in the Contract Documents. The Contractor shall be solely responsible for means, methods, techniques, sequences, or procedures of construction and any associated building code requirements.

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## 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Special Inspections requirements apply to work detailed in other Sections of the Specifications. Special Inspections requirements shall be in addition to any other inspection or quality control requirements detailed in other Sections of the Specifications. See individual Specification Sections for type of work in question.

## 1.03 DEFINITIONS

A. Periodic Special Inspections: The part-time or intermittent observation of work requiring Special Inspection by a Special Inspector who is present in the area where the work has been or is being performed and at the completion of the work.

B. Continuous Special Inspections: The full-time observation of work requiring Special Inspection by a Special Inspector who is present in the area where the work is being performed.

C. Engineer of Record (EOR): The engineer of each system in responsible charge for the design of each specific building system including structural, mechanical, electrical, and architectural components

D. Registered Design Professional in Responsible Charge (RDPIRC): The RDPIRC in charge of Special Inspections during construction for each specific building system including structural, mechanical, electrical, and architectural components. The RDPIRC shall be a currently Registered Professional Engineer in the State or Commonwealth in which the project is located. The EOR may serve in this role.

E. Special Inspections Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, which has been approved by the Building Official and is retained by the Owner. The EOR may serve in this role where qualifications for specific inspection tasks are met.

F. Special Inspector: Individual employed by or retained by the Special Inspections Agency who is qualified in inspection of specific aspects or components of the construction and conducts inspection activities in these specific aspects of the construction, as required by this Section. The EOR may serve in this role where qualifications for specific inspection tasks are met.

G. Statement of Special Inspections: Document prepared by the EOR or RDPIRC and submitted to the Building Official which identifies the type and extent of required Special Inspections.

H. Approved Fabricator: Fabricator who has been registered and approved by the Building Official to manufacture or fabricate specific components of the construction without Special Inspections.

## 1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents and all other documents referenced in the Specifications. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia State Minimum Standard Building Code

2. ACI 318 – Building Code Requirements for Structural Concrete

3. TMS 402/TMS 602 – Building Code for Masonry Structures/Specifications for Masonry Structures

4. AISC – Code of Standard Practice

5. AISC 341 – Seismic Provisions for Structural Steel Buildings

6. AISC 360 – Specification for Structural Steel Buildings

7. AISC 348 – Specification for Structural Joints Using High Strength Bolts

8. AWS – Structural Welding Code

9. ADMI – Aluminum Design Manual: A Specification for Aluminum Structures

## 1.05 SUBMITTALS

A. The Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. The Contractor shall submit a written statement of responsibility to the Building Official and RDPIRC prior to beginning work. A statement is required from the Contractor, Subcontractor, or Manufacturer who has responsibility for construction or fabrication of a main wind- or seismic-force-resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections.

2. The Contractor shall submit qualifications of any fabricators they intend to use that may qualify as Approved Fabricators to the Special Inspections Agency for review.

B. The Special Inspections Agency shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. The Special Inspections Agency shall provide a statement of qualifications showing relative experience, training, and certification(s) for each Special Inspector to the Building Official, if requested.

2. The Special Inspections Agency shall review fabricator qualifications and submit them to the Building Official for approval as an Approved Fabricator if requested.

3. Special Inspectors shall keep detailed inspection records, including all inspections, tests, similar services, and any discrepancies and corrections. Any discrepancies and corrections shall be reported to the Building Official, the EOR, and the RDPIRC in all required reports, unless otherwise required by the Building Official.

4. The Special Inspections Agency shall submit Interim Reports to the Building Official and the RDPIRC documenting required Special Inspections and correction of any discrepancies at the frequency specified in the Statement of Special Inspections.

5. The Special Inspections Agency shall submit to the Building Official and the RDPIRC a Final Report documenting required Special Inspections and correction of any discrepancies. The Final Report shall be submitted at a point in time agreed upon by the Owner and the Building Official at the Pre-inspection Meeting.

6. Where work is done by Approved Fabricators, the Special Inspections Agency shall coordinate the submittal of a certificate of compliance to the Building Official, the EOR, and the RDPIRC.

## 1.06 SPECIAL INSPECTOR QUALIFICATIONS

A. Special Inspectors shall meet minimum qualifications established by the Building Official and shall be approved by the Building Official.

## 1.07 OFF-SITE FABRICATIONS

A. When structural elements or assemblies are fabricated off site, Special Inspections shall be performed in the fabricator's shop unless the fabricator is an Approved Fabricator. Special Inspections are not required if work is done on the premises of an Approved Fabricator.

B. Fabricators shall maintain detailed fabrication and quality control procedures to ensure workmanship and conformance with Contract Documents and reference standards. The Special Inspections Agency shall review the fabricator's quality control procedures and coordinate required Special Inspections with the fabricator and the Contractor.

C. The Contractor shall submit qualifications of fabricators seeking Approved Fabricator status to the Special Inspections Agency for review. Approval as an Approved Fabricator shall be given by the Building Official upon the recommendation of the Special Inspections Agency or upon review of the fabricator's written fabrication procedures and quality control manuals that provide a basis for control of materials and workmanship, with periodic auditing of fabrication and quality control practices by an Approved Agency or the Building Official.

D. At completion of fabrication, the Approved Fabricator shall submit a certificate of compliance to the Owner or the RDPIRC for submittal to the Building Official stating that the work was performed in accordance with the approved Contract Documents.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 PRE-INSPECTION MEETING

A. At least two weeks prior to beginning work, a Pre-inspection Meeting shall be held to discuss the Special Inspection procedures and submittals. The following parties shall participate: EOR, RDPIRC, Special Inspections Agency representative, Contractor, Subcontractors, Testing Agencies, and Building Official. The type of meeting (in-person or teleconference) and location of meeting shall be determined by the Building Official.

### 3.02 STATEMENT AND SCHEDULE OF SPECIAL INSPECTIONS

A. The Special Inspections Agency and all Special Inspectors are required to comply with all requirements of the Statement of Special Inspections and the Schedule of Special Inspections. Together, these documents identify materials, systems, components, and work that are required to have Special Inspections, the type and extent of Special Inspections, and whether they will be continuous or periodic. The Schedule of Special Inspections is included at the end of this Section. A form which may be used for the Statement of Special Inspections is also included at the end of this Section.

### 3.03 SPECIAL INSPECTIONS AGENCY REQUIREMENTS AND RESPONSIBILITIES

A. The Special Inspections Agency shall be an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, which has been approved by the Building Official and is retained by the Owner. The Agency shall demonstrate competence, to the satisfaction of the Building Official, for the inspection of the specific aspects of construction or operation requiring Special Inspection.

B. The Special Inspections Agency shall maintain detailed inspection records, including a copy at the jobsite, and all records shall be available upon request by the EOR, RDPIRC or the Building Official. The Agency shall submit all required reports to the EOR, RDPIRC and Building Official. Where EOR approval is required for corrections, the Special Inspector shall maintain copies of all related correspondence and submit with all required reports. The Agency shall coordinate all required Special Inspection activities with the Special Inspectors, the Contractor, and any fabricators and shall coordinate designation of fabricators as Approved Fabricators when requested.

## 3.04 SPECIAL INSPECTORS' REQUIREMENTS AND RESPONSIBILITIES

A. All Special Inspectors shall meet the qualification requirements determined by the Building Official for the specific type of inspection services they will be providing and shall be approved by the Building Official. Special Inspectors shall submit written documentation demonstrating their competence and experience or training to the Building Official for approval of their qualifications.

B. Special Inspections shall be performed in accordance with all requirements of the Statement of Special Inspections, the Schedule of Special Inspections, the IBC, and any State or local amendments. Special Inspectors shall maintain detailed inspection records, including a copy at the jobsite, and all records shall be available upon request by the EOR, RDPIRC, or the Building Official. Special Inspectors shall submit all required reports to the RDPIRC and the Building Official. Where EOR approval is required for corrections, the Special Inspector shall maintain copies of all related correspondence and submit with all required reports. Special Inspectors shall coordinate inspection requirements and time when inspections can be conducted with the Contractor.

C. Any discrepancies in work noted by the Special Inspector shall be brought to the immediate attention of the Contractor for correction. Special Inspectors shall coordinate correction of discrepancies with the Contractor. Any corrections of discrepancies that result in changes to the work as shown on the Contract Documents shall be approved by the EOR. If noted discrepancies are not corrected, the Special Inspector shall notify the Contractor, the EOR, the RDPIRC and the Building Official. All noted discrepancies and corrections shall be documented in all inspection records and all required reports.

## 3.05 CONTRACTOR RESPONSIBILITIES

A. The Contractor, Subcontractor, or Manufacturer responsible for the construction or fabrication of a main wind- or seismic-force-resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections shall submit a Statement of Responsibility to the Building Official, RDPIRC, and EOR prior to the commencement of work. The Statement of Responsibility shall contain acknowledgement of the specific requirements contained in the Statement of Special Inspections.

B. The Contractor shall coordinate requirements of Special Inspections with the Special Inspections Agency and the Special Inspectors and shall provide adequate time and access to conduct inspections. The Contractor is solely responsible for providing safe access and any necessary safety equipment required to conduct inspections. The Special Inspector shall not supervise, direct, control, or have authority over or be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of the Contractor to comply with Laws and Regulations applicable to the performance of the Work.

C. Special Inspections shall not relieve the Contractor's obligation to perform and complete work in accordance with the Contract Documents. Results of Special Inspections activities, including any discrepancies that are noted or not noted, shall never constitute an acceptance of work that is not in accordance with the Contract Documents.

D. The Contractor shall provide advance notice of work to be conducted that will require Special Inspections. If the Special Inspector is delayed in inspecting the work due to inadequate notice or completion of the work, the Contractor shall reimburse the Owner for the cost of additional subsequent Special Inspections.

E. The Contractor shall promptly correct any discrepancies noted by the Special Inspectors. Any corrections of discrepancies that result in changes to the work as shown on the Contract Documents shall be approved by the EOR. Where EOR approval is required, the Contractor shall report the discrepancy to the EOR in accordance with provisions of the General Conditions. The EOR will authorize any changes to the Contract Documents required for the correction in accordance with provisions of the General Conditions. Copies of all correspondence related to the correction shall be submitted concurrently to the Special Inspections Agency.

## 3.06 BUILDING OFFICIAL OR AUTHORITY RESPONSIBILITIES

A. The Building Official will approve qualifications of the Special Inspections Agency, all Special Inspectors, and any Approved Fabricators. The Building Official will approve all forms submitted by the Contractor, any Approved Fabricators, the EOR, the RDPIRC, the Special Inspections Agency, and the Special Inspectors. The Building Official and the Special Inspections Agency shall agree to the frequency of Interim Reports and the submittal deadline for the Final Report.

## 3.07 RDPIRC RESPONSIBILITIES

A. The RDPIRC shall complete the Statement of Special Inspections and the Schedule of Special Inspections, unless previously completed by the EOR. The Statement of Special Inspections form included in this Section shall be used unless the Building Official has a preferred form for the Statement of Special Inspections, in which case the Building Official's form may be used and shall be completed by the RDPIRC.

B. The RDPIRC shall review and coordinate certain aspects of the project, as determined by the Building Official, for compatibility with the design of the building, structure or building system, including, but not limited to, submittal documents prepared by others, deferred submittal documents and phased submittal documents.

## 3.08 OWNER RESPONSIBILITES

A. The Owner will retain a Special Inspections Agency to perform Special Inspections during construction. The Special Inspections Agency will retain the RDPIRC.

## 3.09 MINIMUM INSPECTION REQUIREMENTS

A. Detailed requirements for Special Inspections are shown in the Statement of Special Inspections and the Schedule of Special Inspections, which references the IBC, applicable code standards, and any State or local amendments. Special Inspections shall be performed in accordance with all requirements of the Statement of Special Inspections, the Schedule of Special Inspections, the IBC, and any State or local amendments. Additional requirements for specific materials listed in other Sections of these Specifications shall also be satisfied. The frequency of inspections shall be continuous or periodic as indicated in the Schedule of Special Inspections and in accordance with applicable building codes.

## 3.10 REPORTS

A. Special Inspectors shall maintain detailed inspection records, including a copy at the jobsite, and all records shall be available upon request by the EOR, RDPIRC or the Building Official. The Special Inspections Agency shall submit all required reports to the Building Official, EOR, and RDPIRC as agreed upon with the Building Official. Reports shall indicate the inspections and testing performed and whether work inspected was or was not completed in conformance to Contract Documents and any corrective measures taken. Where EOR approval is required for corrections, the Agency shall maintain copies of all related correspondence and submit with all required reports.

## 3.11 SPECIAL INSPECTIONS FORMS

A. This Section includes forms which may be used to meet requirements for written documentation during the performance of Special Inspections in accordance with the IBC. These forms may be replaced with forms meeting IBC requirements provided by the Building Official if available.

## SCHEDULE OF SPECIAL INSPECTIONS (IBC 2018 VERSION)

### 1 – STEEL CONSTRUCTION (IBC 2018/AISC 360-16)

### 1.1 STRUCTURAL STEEL

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| **1. Inspection Tasks Prior to Welding:** | | | | |
| a. | Welder qualification records and continuity records | | | |
| | 1) Quality Assurance provided by inspector | | O | |
| | 2) Quality Control provided by fabricator, erector, or contractor | P | | |
| b. | WPS available | P | | |
| c. | Manufacturer certifications for welding consumables available | P | | |
| d. | Material identification (type/grade) | | O | |
| e. | Welder identification system* | | O | |
| f. | Fit-up of groove welds (including joint geometry)<br>1) Joint preparations<br>2) Dimensions (alignment, root opening, root face, bevel)<br>3) Cleanliness (condition of steel surfaces)<br>4) Tacking (tack weld quality and location)<br>5) Backing type and fit (if applicable) | | O | |
| g. | Fit-up of CJP groove welds of HSS T-, Y- and K-joints without backing (including joint geometry) - Quality Assurance provided by inspector<br>1) Joint preparations<br>2) Dimensions (alignment, root opening, root face, bevel)<br>3) Cleanliness (condition of steel surfaces)<br>4) Tacking (tack weld quality and location) | | O | |
| h. | Configuration and finish of access holes | | O | |
| i. | Fit-up of fillet welds<br>1) Dimensions (alignment, gaps at root)<br>2) Cleanliness (condition of steel surfaces)<br>3) Tacking (tack weld quality and location) | | O | |
| j. | Check welding equipment | | O | |

* The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| **2. Inspection Tasks During Welding:** | | | | |
| a. | Control and handling of welding consumables<br>1) Packaging<br>2) Exposure control | | O | |
| b. | No welding over cracked tack welds | | O | |
| c. | Environmental conditions<br>1) Wind speed within limits<br>2) Precipitation and temperature | | O | |
| d. | WPS followed<br>1) Settings on welding equipment<br>2) Travel speed<br>3) Selected welding materials<br>4) Shielding gas type/flow rate<br>5) Preheat applied<br>6) Interpass temperature maintained (min/max)<br>7) Proper position (F, V, H, OH) | | O | |
| e. | Welding techniques<br>1) Interpass and final cleaning<br>2) Each pass within profile limitations<br>3) Each pass meets quality requirements | | O | |
| f. | Placement and installation of steel headed stud anchors | P | | |
| **3. Inspection Tasks After Welding:** | | | | |
| a. | Welds cleaned | | O | |
| b. | Size, length, and location of welds | P | | |
| c. | Welds meet visual acceptance criteria<br>1) Crack prohibition<br>2) Weld/base-metal fusion<br>3) Crater cross section<br>4) Weld profiles<br>5) Weld size<br>6) Undercut<br>7) Porosity | P | | |
| d. | Arc strikes | P | | |
| e. | k-area ** | P | | |
| f. | Weld access holes in rolled heavy shapes and built-up heavy shapes*** | P | | |
| g. | Backing removed and weld tabs removed (if required) | P | | |

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| h. | Repair activities | P | | |
| i. | Document acceptance or rejection of welded joint or member | P | | |
| j. | No prohibited welds have been added without the approval of the EOR | | O | |
| ** When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 inches of the weld.<br><br>*** After rolled heavy shapes (see AISC 360 Section A3.1c) and built-up heavy shapes (see AISC 360 Section A3.1d) are welded, visually inspect the weld access hole for cracks. | | | | |
| **4. Inspection Tasks Prior to Bolting:** | | | | |
| a. | Manufacturer's certifications available for fastener materials | | | |
| | 1) Quality assurance provided by inspector | P | | |
| | 2) Quality control provided by fabricator, erector, or contractor | | O | |
| b. | Fasteners marked in accordance with ASTM requirements | | O | |
| c. | Correct fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane) | | O | |
| d. | Correct bolting procedure selected for joint detail | | O | |
| e. | Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements | | O | |
| f. | Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used | | | |
| | 1) Quality Assurance provided by inspector | | O | |
| | 2) Quality Control provided by fabricator, erector, or contractor | P | | |
| g. | Protected storage provided for bolts, nuts, washers, and other fastener components | | O | |
| **5. Inspection Tasks During Bolting:** | | | | |
| a. | Fastener assemblies placed in all holes and washers and nuts are positioned as required | | O | |
| b. | Joint brought to the snug-tight condition prior to the pre-tensioning operation | | O | |
| c. | Fastener component not turned by the wrench prevented from rotating | | O | |
| d. | Fasteners are pre-tensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges | | O | |

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| **6. Inspection Tasks After Bolting:** | | | | |
| a. | Document acceptance or rejection of bolted connections | P | | |

Structural Steel Definitions:

Observe (O) - The inspector shall observe these items on a random basis. Operations need not be delayed pending these inspections.

Perform (P) - These tasks shall be performed for each welded joint or member and for each bolted connection.

TABLE 1.1 - STRUCTURAL STEEL REFERENCES:

1. Welded Steel Construction Reference Standard AISC 360-16, Section N5.4.
2. Bolted Steel Construction Reference Standard AISC 360-16, Section N5.6.

## 1.2 COLD-FORMED STEEL DECK (IBC 2018/SDI QA/QC 17)

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| **1. Inspection or Execution Tasks Prior to Deck Placement:** | | | | |
| a. | Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness | P | | |
| b. | Document acceptance or rejection of deck and deck accessories | P | | |
| **2. Inspection or Execution Tasks After Deck Placement:** | | | | |
| a. | Verify compliance of deck and all deck accessories installation with construction documents | P | | |
| b. | Verify deck materials are represented by the mill certifications that comply with the construction documents | P | | |
| c. | Document acceptance or rejection of installation of deck and deck accessories | P | | |
| **3. Inspection or Execution Tasks Prior to Welding:** | | | | |
| a. | Welding procedure specifications (WPS) available | | O | |
| b. | Manufacturer certifications for welding consumables available | | O | |
| c. | Material identification (type/grade) | | O | |
| d. | Check welding equipment | | O | |

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| **4. Inspection or Execution Tasks During Welding:** | | | | |
| a. | Use of qualified welders | | O | |
| b. | Control and handling of welding consumables | | O | |
| c. | Environmental conditions (wind speed, moisture, temperature) | | O | |
| d. | WPS followed | | O | |
| **5. Inspection or Execution Tasks After Welding:** | | | | |
| a. | Verify size and location of welds, including support, sidelap, and perimeter welds | P | | |
| b. | Welds meet visual acceptance criteria | P | | |
| c. | Verify repair activities | P | | |
| d. | Document acceptance or rejection of welds | P | | |
| **6. Inspection or Execution Tasks Prior to Mechanical Fastening:** | | | | |
| a. | Manufacturer installation instructions available for mechanical fasteners | | O | |
| b. | Proper tools available for fastener installation | | O | |
| c. | Proper storage for mechanical fasteners | | O | |
| **7. Inspection or Execution Tasks During Mechanical Fastening:** | | | | |
| a. | Fasteners are positioned as required | | O | |
| b. | Fasteners are installed in accordance with manufacturer’s instructions | | O | |
| **8. Inspection or Execution Tasks After Mechanical Fastening:** | | | | |
| a. | Check spacing, type, and installation of support fasteners | P | | |
| b. | Check spacing, type, and installation of sidelap fasteners | P | | |
| c. | Check spacing, type, and installation of perimeter fasteners | P | | |
| d. | Verify repair activities | P | | |

| Inspection Task | | Frequency | | Applicable to Project |
|---|---|---|---|---|
| | | CONT | PER | Y/N |
| e. | Document acceptance or rejection of mechanical fasteners | P | | |

Cold-Formed Steel Deck Definitions:

Observe (O) – The inspector shall observe these items on an intermittent basis. Operations need not be delayed pending these inspections.

Perform (P) – These tasks shall be performed for each item or element.

TABLE 1.2 - COLD FORMED STEEL DECK REFERENCES:

1. SDI QA/QC – 2017.

### 1.3 OPEN-WEB STEEL JOISTS AND JOIST GIRDERS (IBC 2018/SJI 100-15 & 200-15)

| Inspection Task | | Frequency | | Applicable to Project | Reference Standard | IBC Reference |
|---|---|---|---|---|---|---|
| | | CONT | PER | Y/N | | |
| **1. Inspection of open-web steel joists and joist girders:** | | | | | SJI specifications listed in IBC Section 2207.1 | 1705.2.3 |
| a. | End connections – welding or bolted | | X | | | |
| b. | Bridging – horizontal or diagonal | | | | SJI specifications listed in IBC Section 2207.1 | |
| | 1) Standard bridging | | X | | | |
| | 2) Bridging that differs from the SJI specifications listed in IBC Section 2207.1 | | X | | | |
| * Where applicable, see Section 1705.12, Special Inspections for Seismic Resistance. | | | | | | |

TABLE 1.3 - OPEN-WEB STEEL JOISTS AND JOIST GIRDERS REFERENCES:

1. SJI 100-15 & SJI 200-15.

**2 - CONCRETE CONSTRUCTION (IBC 2018/ACI 318-14)**

| Inspection Task | | Frequency | | Applicable to Project | Reference Standard | IBC Reference |
|---|---|---|---|---|---|---|
| | | CONT | PER | Y/N | | |
| **1. Inspect reinforcement, including prestressing tendons, and verify placement** | | | X | | ACI 318: Ch 20, 25.2, 25.3, 26.6.1-26.6.3 | 1705.3, 1908.4 |
| **2. Reinforcing bar welding:** | | | | | AWS D1.4, ACI 318: 26.6.4 | 1705.3 |
| a. | Verify weldability of reinforcing bars other than ASTM A706 | | X | | | |
| b. | Inspect single-pass fillet welds, maximum 5/16” | | X | | | |
| c. | Inspect all other welds | X | | | | |
| **3. Inspect anchors cast in concrete** | | | X | | ACI 318: 17.8.2 | 1705.3 |
| **4. Inspect anchors post-installed in hardened concrete members:** ** | | | | | ACI 318: 17.8.2.4, ACI 318: 17.8.2 | 1705.3 |
| a. | Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads | X | | | | |
| b. | Mechanical anchors and adhesive anchors not defined in 4.a | | X | | | |
| **5. Verify use of required design mix** | | X | | | ACI 318: Ch 19, 26.4.3, 26.4.4 | 1705.3, 1904.1, 1904.2, 1908.2, 1908.3 |
| **6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete** | | X | | | ASTM C172, ASTM C31, ACI 318: 26.5, 26.12 | 1705.3, 1908.10 |
| **7. Inspect concrete and shotcrete placement for proper application techniques** | | X | | | ACI 318: 26.5 | 1705.3, 1908.6, 1908.7, 1908.8 |
| **8. Verify maintenance of specified curing temperature and techniques. Verify curing method and duration of curing for each member.** | | | X | | ACI 318: 26.5.3-26.5.5, 26.13.3.3 | 1705.3, 1908.9 |
| **9. Inspect prestressed concrete for:** | | X | | | ACI 318: 26.10 | 1705.3 |
| a. | Application of prestressing forces. | | | | | |
| b. | Grouting of bonded prestressing tendons. | | | | | |

| Inspection Task | Frequency | | Applicable to Project | Reference Standard | IBC Reference |
|---|---|---|---|---|---|
| | CONT | PER | Y/N | | |
| **10. Inspect erection of precast concrete members. Inspect sequence of erection and connection of precast members.** | | X | | ACI 318: 26.9, 26.13.3.3 | 1705.3 |
| **11. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.** | | X | | ACI 318: 26.11.2 | 1705.3 |
| **12. Inspect formwork for shape, location, and dimensions of the concrete member being formed. Inspect construction and removal of forms and shoring.** | | X | | ACI 318: 26.11.1.2(b), 26.13.3.3 | 1705.3 |
| * Where applicable, see Section 1705.12 - Special Inspections for Seismic Resistance - Concrete<br>** Specific requirements for Special Inspection shall be included in the research report for the anchor issued by an approved source in accordance with 17.8.2 in ACI 318, or other qualification procedures. Where specific requirements are not provided, Special Inspection requirements shall be specified by the registered design professional and shall be approved by the building official prior to the commencement of the work. | | | | | |

NOTES:

1. ACI 318 Referenced Standard refers to the 2014 edition.
2. Concrete patios, driveways and sidewalks on grade are exempt from Special Inspection requirements.

**3 - MASONRY CONSTRUCTION - LEVEL 2 QUALITY ASSURANCE (IBC 2018/TMS 402 & 602)**

| Inspection Task | Applicable to Project | Reference Standard | | IBC Reference |
|---|---|---|---|---|
| | Y/N | TMS 402 | TMS 602 | |
| Prior to construction, verification of compliance of submittals. | | | ART. 1.5 | 1705.4 |
| Prior to construction, verification of f'm, except where specifically exempted by the Code. | | | ART. 1.4B | |
| During construction, verification of slump flow and visual stability index (VSI) when self-consolidating grout is delivered to the project site. | | | ART. 1.5, 1.6.3 | |

| Minimum Special Inspection | | Frequency | | Applicable to Project | Reference Standard | | IBC Reference |
|---|---|---|---|---|---|---|---|
| | | CONT | PER | Y/N | TMS 402 | TMS 602 | |
| **1. As masonry construction begins, verify that the following comply:** | | | | | | | 1705.4 |
| a. | Proportions of site-prepared mortar. | | X | | | ART. 2.1, 2.6A, 2.6C | |
| b. | Grade, type and size of reinforcement, connectors, and anchor bolts. | | X | | | ART. 3.4, 3.6A | |
| c. | Sample panel construction. | | X | | | ART. 1.6D | |
| **2. Prior on grouting, verify that the following comply:** | | | | | | | |
| a. | Grout space. | | X | | | ART. 3.2D, 3.2F | |
| b. | Placement of reinforcement, connectors, and anchor bolts. | | X | | SEC. 6.1, 6.3.1, 6.3.6, 6.3.7 | ART. 3.2E, 3.4 | |
| c. | Proportions of site-prepared grout. | | X | | | ART. 2.6B, 2.4 G.1.b | |
| **3. Verify compliance of the following during construction:** | | | | | | | 1705.4 |
| a. | Materials and procedures with approved submittals. | | X | | | ART. 1.5 | |
| b. | Placement of masonry units and mortar joint construction. | | X | | | ART. 3.3B | |
| c. | Size and location of structural members. | | X | | | ART. 3.3F | |

| Minimum Special Inspection | | Frequency | | Applicable to Project | Reference Standard | | IBC Reference |
|---|---|---|---|---|---|---|---|
| | | CONT | PER | Y/N | TMS 402 | TMS 602 | |
| d. | Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction. | | X | | SEC. 1.2.1(e), 6.2.1, 6.3.1 | | 1705.4 |
| e. | Welding of reinforcement. | X | | | SEC. 6.1.6.1.2 | | |
| f. | Preparation, construction, and protection of masonry during cold weather (temperature below 40° F) or hot weather (temperatures above 90° F). | | X | | | ART. 1.8C, 1.8D | |
| g. | Placement of grout is in compliance. | X | | | | ART. 3.5, 3.6C | |
| **4. Observe preparation of grout specimens, mortar specimens, and/or prisms.** | | | X | | | ART. 1.4B.2.a.3, 1.4B.2.b.3, 1.4B.2.c.3, 1.4B.3, 1.4B.4 | 1705.4 |

TABLE 3 - MASONRY CONSTRUCTION REFERENCES:

1. Level 2 quality assurance in accordance with TMS 402/602-16.

## 4 - DEEP FOUNDATION ELEMENTS (IBC 2018)

### 4.1 DRIVEN DEEP FOUNDATION ELEMENTS (IBC 2018)

| Inspection Task | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| 1. Verify element materials, sizes and lengths comply with the requirements. | X | | | 1705.7 |
| 2. Determine capacities of test elements and conduct additional load tests, as required. | X | | | |
| 3. Inspect driving operations and maintain complete and accurate records for each element. | X | | | |
| 4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element. | X | | | |
| 5. For steel elements, perform additional Special Inspections in accordance with Section 1705.2. (see Table 1.1) | | | | 1705.7, 1705.2 |
| 6. For concrete elements and concrete-filled elements, perform tests and additional Special Inspections in accordance with Section 1705.3. (see Table 2) | | | | 1705.7, 1705.3 |
| 7. For specialty elements, perform additional inspections as determined by the Registered Design Professional in Responsible Charge. | | | | 1705.7 |

**4.2 CAST-IN-PLACE DEEP FOUNDATION ELEMENTS (IBC 2018)**

| Inspection Task | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| 1. Inspect drilling operations and maintain complete and accurate records for each element. | X | | | 1705.8 |
| 2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes. | X | | | |
| 3. For concrete elements, perform tests and additional Special Inspections in accordance with Section 1705.3. (See Table 2) | | | | 1705.8, 1705.3 |

**4.3 HELICAL PILES (IBC 2018)**

| Inspection Task | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| 1. Helical pile foundation installation: Information recorded shall include installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required by the Registered Design Professional in Responsible Charge. The approved Geotechnical Report and Contract Documents shall be used to determine compliance. | X | | | 1705.9 |

**5 - SOILS (IBC 2018)**

| Inspection Task | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| 1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity. | | X | | 1705.6 |
| 2. Verify excavations are extended to proper depth and have reached proper material. | | X | | |

| Inspection Task | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| **3. Perform classification and testing of compacted fill materials.** | | X | | |
| **4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of the compacted fill.** | X | | | 1705.6 |
| **5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.** | | X | | |

**6 - ARCHITECTURAL COMPONENTS* - (IBC 2018)**

| Inspection Task | | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|---|
| | | CONT | PER | Y/N | |
| **1. Sprayed fire-resistant materials:** | | | | | |
| a. | Special Inspection shall be based on the fire-resistance design as designated in the approved construction documents and shall be performed after the rough installation of electrical, automatic sprinkler, mechanical and plumbing systems, and suspension systems for ceilings, where applicable. Tests shall include the following to demonstrate compliance with the listing and the fire-resistance rating.<br><br>1) Condition of substrates<br>2) Thickness of application<br>3) Density in pounds per cubic foot<br>4) Bond strength adhesion/cohesion<br>5) Condition of finished application | | X | | 1705.14 |

| Inspection Task | | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|---|
| | | CONT | PER | Y/N | |
| **2. Mastic and intumescent fire-resistant coatings:** | | | X | | 1705.15 |
| a. | Special Inspections shall be based on the fire-resistance design as designated in the approved construction documents. | | X | | |
| **3. Exterior Insulation and Finish systems (EIFS):** | | | | | 1705.16 |
| a. | Special Inspections are required for all EIFS applications. Exceptions:<br>1) EIFS applications installed over a water-resistive barrier with a means of draining moisture to the exterior<br>2) EIFS applications installed over masonry or concrete walls | | X | | |
| b. | A water-resistive barrier coating complying with ASTM E2570 requires Special Inspection of the water-resistive barrier coating where installed over a sheathing substrate. | | X | | |
| **4. Smoke control:** | | | | | 1705.18 |
| a. | Test scope shall be as follows:<br>1) During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location<br>2) Prior to occupancy and after sufficient completion for the purposes of pressure difference testing, flow measurements and detection and control verification | | X | | |
| b. | Approved agencies for smoke control testing shall have expertise in fire protection engineering, mechanical engineering, and certification as air balancers. | | X | | |

| Inspection Task | | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|---|
| | | CONT | PER | Y/N | |
| **5. Fire-resistant penetrations and joints:** | | | | | |
| a. | In buildings assigned to Risk Category III or IV, Special Inspections for through-penetrations, membrane penetration firestops, fire-resistant joint systems, and perimeter fire barrier systems that are tested and listed in accordance with IBC Section 714.4.1.2, 714.5.1.2, 715.3 and 715.4 shall be in accordance with Section 1705.17.1 or 1705.17.2 | | X | | 1705.17 |
| * Where applicable, see additional tasks in Table 7.3.2 Special Inspections for Seismic Resistance - Architectural Components | | | | | |

## 7 - SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE (IBC 2018)

Special Inspections and Testing for Seismic Resistance are required in accordance with IBC 1705.12 and IBC 1705.13.

Seismic Force Resisting Systems [required for SDC B, C, D, E or F]: _____

Designated Seismic Systems [required for SDC C, D, E or F]: _____

## 7.1 - SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE - STRUCTURAL STEEL (IBC 2018/AISC 341)

Inspection tasks apply to:

I. Seismic Force Resisting Systems in buildings and structures assigned to SDC B, C, D, E or F. Required inspections and tests are listed in Table 1.1 and Table 7.1.
   Exceptions:
   1) For SDC B or C, not required where value of R used for design and detailing is based on "Steel Systems Not Specifically Detailed for Seismic Resistance, Excluding Cantilever Column Systems" as per ASCE 7 Table 12.2-1.
   2) For SDC D, E or F, not required where design and detailing in accordance with AISC 360 is permitted by ASCE 7, Table 15.4-1.

II. Structural Steel elements in the Seismic Force Resisting Systems in buildings and structures assigned to SDC B, C, D, E or F other than those in item I above. This includes but is not limited to struts, collectors, chords and foundation elements. Required inspections and tests are listed in Table 1.1 and Table 7.1.
   Exceptions:
   1) For SDC B or C, not required where R=3 or less as per ASCE 7.
   2) For SDC D, E or F, not required where design and detailing other than AISC 341 is permitted by ASCE 7, Table 15.4-1. Special Inspection shall be in accordance with applicable referenced standard in ASCE 7, Table 15.4-1.

| **Inspection Task*** | | **Frequency** | | **Applicable to Project** |
|---|---|---|---|---|
| | | **CONT** | **PER** | **Y/N** |
| **1. Visual Inspection Tasks Prior to Welding - See Table 1.1 for Tasks** | | | | |
| **2. Visual Inspection Tasks During Welding – See Table 1.1 for Tasks** | | | | |
| d. | WPS followed | | O | |
| | 8) Intermix of filler metals avoided unless approved | | | |
| g. | Use of qualified welders | | O | |
| **3. Visual Inspection Tasks After Welding - See Table 1.1 for Tasks** | | | | |
| e. | k-area ** | P | D | |
| g. | Backing removed and weld tabs removed and finished, and fillet welds added (if required) | P | D | |
| i. | Document acceptance or rejection of welded joint or member | P | D | |

| | | | | |
|---|---|---|---|---|
| k. | Placement of reinforcing or contouring fillet welds (if required) | P | D | |
| ** When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 inches of the weld. The visual inspection shall be performed no sooner than 48 hours following completion of the welding. | | | | |
| **4. Inspection Tasks Prior To Bolting - See Table 1.1 for Tasks** | | | | |
| f. | Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used | | | |
| | 1) Quality assurance provided by Inspector | | O, D | |
| | 2) Quality control provided by Fabricator, Erector, or Contractor | P | | |
| **5. Inspection Tasks During Bolting - See Table 1.1 for Tasks** | | | | |
| **6. Inspection Tasks After Bolting** | | | | |
| a. | Document acceptance or rejection of bolted connections | P | D | |
| **7.** | **Other inspection tasks** | | | |
| a. | RBS requirements, if applicable | | | |
| | 1) Contour and finish | P | D | |
| | 2) Dimensional tolerances | P | D | |
| b. | Protected Zone - No holes and unapproved attachments made by fabricator or erector, as applicable | P | D | |
| **8. Inspection of Composite Structures Prior to Concrete Placement** | | | | |
| a. | Material identification of reinforcing steel (type/grade) | | O | |
| b. | Determination of carbon equivalent for reinforcing steel other than ASTM A706/ASTM 706M | | O | |
| c. | Proper reinforcing steel size, spacing and orientation | | O | |
| d. | Reinforcing steel has not been rebent in the field | | O | |
| e. | Reinforcing steel has been tied and supported as required | | O | |
| f. | Required reinforcing steel clearances have been provided | | O | |
| g. | Composite member has required size | | O | |
| **9. Inspection Of Composite Structures During Concrete Placement** | | | | |
| a. | Concrete: material identification (mix design, compressive strength, maximum large aggregate size, maximum slump) | | O, D | |
| b. | Limits on water added at the truck or pump | | O, D | |
| c. | Proper placement techniques to limit segregation | | O | |
| **10. Inspection Of Composite Structures After Concrete Placement** | | | | |
| a. | Achievement of minimum specified concrete compressive strength at specified age | | D | |

| | | | | |
|---|---|---|---|---|
| **11. Inspection Of H-Piles** | | | | |
| a. | Protected zone - no holes and unapproved attachments made by the responsible contractor, as applicable | P | D | |

* Tasks listed in Table 1.1 are not repeated here but are still required. Tasks listed in Table 7.1 apply in addition to tasks listed in Table 1.1.

Structural Steel Definitions:

Observe (O) - The inspector shall observe these items on a random daily basis. Operations need not be delayed pending these inspections.

Perform (P) - These inspections shall be performed prior to the final acceptance of the item.

Document (D) - The inspector shall prepare reports indicating that the work has been performed in accordance with the Contract Documents.

## 7.2 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE - CONCRETE* (ACI 318-14)

| INSPECTION TASK | Frequency | | Applicable to Project | Reference Standard | IBC Reference |
|---|---|---|---|---|---|
| | CONT | PER | Y/N | | |
| **1. Reinforcement for Special Moment Frames.** | X | | | ACI 318 26.13.3 | 1705.12 |

* Tasks listed in Table 2 are not repeated here but are still required. Tasks listed in Table 7.2 apply in addition to tasks listed in Table 2.

**7.3 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE - NONSTRUCTURAL COMPONENTS (IBC 2018/ASCE 7-16)**

| Inspection Task | | Frequency | | Applicable to Project | Reference Standard | IBC Reference |
|---|---|---|---|---|---|---|
| | | CONT | PER | Y/N | | |
| **1. Nonstructural components assigned to SDC B,C,D,E or F:** | | | | | ASCE 7 13.2.1 | 1705.13.2 |
| a. | Submittal of the manufacturer's certification that the component is seismically qualified (if certification reqd by ASCE section 13.2.1). | | X | | | |
| **2. Designated seismic systems for nonstructural components:** | | | | | ASCE 7 13.2.2 | 1705.13.3 |
| a. | For structures assigned to SDC C, D, E or F with designated seismic systems requiring seismic qualification in accordance with ASCE 7 Section 13.2.2: | | | | | |
| | 1) Submittal of the manufacturer's certification that the designated seismic systems requiring seismic qualification comply with requirements of ASCE 7 Section 13.2.2. | | X | | | |
| | 2) The Special Inspector shall examine the designated seismic systems requiring seismic qualification and verify that the label, anchorage and mounting conform to the certificate of compliance. | | X | | | |

**7.3.1 - PLUMBING, MECHANICAL AND ELECTRICAL COMPONENTS - (IBC 2018)**

| Inspection Task | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| **1. Observe anchorage of electrical equipment for emergency and standby power systems in structures assigned to SDC C, D, E or F** | | X | | 1705.12.6 |
| **2. Observe anchorage of other electrical equipment in structures assigned to SDC E or F** | | X | | 1705.12.6 |
| **3. Observe installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units in structures assigned to SDC C, D, E or F** | | X | | 1705.12.6 |

| Inspection Task | | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|---|
| | | CONT | PER | Y/N | |
| **4. Observe installation and anchorage of ductwork designed to carry hazardous materials in structures assigned to SDC C, D, E or F** | | | X | | 1705.12.6 |
| **5. Observe installation and anchorage of vibration isolation systems in structures assigned to SDC C, D, E or F where the approved construction documents require a nominal clearance of ¼ inch or less between the equipment support frame and restraint** | | | X | | 1705.12.6 |
| **6. Observe installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic sprinkler systems are installed in structures assigned to SDC C, D, E or F to verify one of the following:** | | | | | 1705.12.6 |
| a. | Minimum clearances have been provided as required by Section 13.2.3 ASCE 7. | | X | | |
| b. | A nominal clearance of not less than 3 inches has been provided between automatic protection sprinkler system drops and sprigs and: structural members not used collectively or independently to support the sprinklers; equipment attached to the building structure; and other systems' piping. | | X | | |
| | Exception: Where flexible sprinkler hose fittings are used, Special Inspection of minimum clearances is not required. | | | | |

**7.3.2 - ARCHITECTURAL COMPONENTS* - (IBC 2018)**

| INSPECTION TASK | | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|---|
| | | CONT | PER | Y/N | |
| **6. Observe erection and fastening of exterior cladding, interior and exterior nonbearing walls and interior and exterior veneer in structures assigned to SDC D, E or F.<br>Exceptions:** | | | X | | 1705.12.5 |
| a. | Exterior cladding, interior and exterior nonbearing walls, and interior and exterior veneer 30 feet or less in height above grade or walking surface. | | | | |
| b. | Exterior cladding and interior and exterior veneer weighing 5 psf or less. | | | | |

| | | | | | |
|---|---|---|---|---|---|
| c. | Interior nonbearing walls weighing 15 psf or less. | | | | |
| **7. Observe anchorage of access floors in structures assigned to SDC D, E or F.** | | | X | | 1705.12.5.1 |
| * Tasks listed in Table 6 are still required. Tasks listed in Table 7.3.2 apply in addition to tasks listed in Table 6. | | | | | |

**7.3.3 - STORAGE RACKS - (IBC 2018)**

| INSPECTION TASK | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| **1. Anchorage installation for storage racks that are 8 feet or greater in height in structures assigned to Seismic Design Category D, E, or F.** | | X | | 1705.12.7 |

**7.3.4 - SEISMIC ISOLATION SYSTEMS (IBC 2018)**

| INSPECTION TASK | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| **1. Observe seismic isolation systems in seismically isolated structures assigned to SDC B, C, D, E or F during the fabrication and installation of isolator units and energy dissipation devices** | | X | | 1705.12.8 |

**8 - SPECIAL INSPECTIONS FOR WIND RESISTANCE (IBC 2018)**

Special Inspections for Wind Resistance are required in accordance with IBC 1705.11.

**8.1 - WIND RESISTING COMPONENTS:**

| INSPECTION TASK | Frequency | | Applicable to Project | IBC Reference |
|---|---|---|---|---|
| | CONT | PER | Y/N | |
| **1. Roof covering, roof deck and roof framing connections** | | X | | 1705.11.3 |
| **2. Exterior wall covering and wall connections to roof and floor diaphragms and framing** | | X | | |

**9. Special Inspections Agency Contact Information:**

1. _____

2. _____

3. _____

4. _____

## STATEMENT OF SPECIAL INSPECTIONS

**PROJECT:** _____

**LOCATION:** _____

**PERMIT APPLICANT:** _____

**APPLICANT'S ADDRESS:** _____

**ARCHITECT OF RECORD:** _____

**STRUCTURAL ENGINEER OF RECORD:** _____

**MECHANICAL ENGINEER OF RECORD:** _____

**ELECTRICAL ENGINEER OF RECORD:** _____

**REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE:** _____

This Statement of Special Inspections is submitted in accordance with Section 1704 of the International Building Code. It shall be considered in conjunction with the Schedule of Special Inspections included in this Specification Section 01 45 33. If applicable, it includes *Requirements for Seismic Resistance and/or Requirements for Wind Resistance*.

Are Requirements for Seismic Resistance included in the Statement of Special Inspections? ☐ Yes ☐ No

Are Requirements for Wind Resistance included in the Statement of Special Inspections? ☐ Yes ☐ No

The Special Inspector(s) shall keep detailed records of all inspections, including a copy at the jobsite. All records shall be available upon request by the Engineer or the Building Official. Any discrepancies shall be brought to the immediate attention of the Contractor. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Engineer prior to completion of that phase of work. The Special Inspections Agency shall furnish Interim Reports to the Building Official and to the Engineer at the frequency indicated in the Statement of Special Inspections. A Final Report shall be submitted to the Building Official and the Engineer at the time agreed upon by the Owner and the Building Official.

**Frequency of Interim Report submittals to the Building Official:**

___ Weekly ___ Bi-Weekly ___ Monthly Other; specify:_____

**Frequency of Interim Report submittals to the Engineer:**

___ Weekly ___ Bi-Weekly ___ Monthly Other; specify:_____

Special Inspections do not relieve the Contractor of the obligation to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

**Statement of Special Inspections Prepared by:**

_____
Type or print name

_____
Signature Date

**Building Official's Acceptance:**

_____
Type or print name

_____
Signature Date

Registered Design Professional's Seal

**STATEMENT OF SPECIAL INSPECTIONS**

**REQUIREMENTS FOR SEISMIC RESISTANCE**

See the Schedule of Special Inspections for inspection and testing requirements.

Seismic Design Category: _____

Statement of Special Inspection for Seismic Resistance Required (Yes/No): _____

**Description of seismic force-resisting system subject to special inspection and testing for seismic resistance:**

**Description of designated seismic systems in accordance with Chapter 13 of ASCE 7 subject to special inspection and testing for seismic resistance. Special inspector shall verify that the label, anchorage and mounting of these systems conforms to the Contract Documents and Approved Submittals:**

**Description of additional seismic systems and components requiring special inspections:**

**Description of additional seismic systems and components requiring testing:**

**Statement of Responsibility:**
The Contractor, Subcontractor, or Manufacturer responsible for the construction or fabrication of a system or component described above must submit a Statement of Responsibility.

**STATEMENT OF SPECIAL INSPECTIONS**

**REQUIREMENTS FOR WIND RESISTANCE**

See the Schedule of Special Inspections for inspection and testing requirements.

**Basic Wind Speed (3 second gust): _____ m.p.h.**

**Wind Exposure Category: _____**

**Statement of Special Inspection for Wind Resistance Required (Yes/No): _____**

**Description of main wind force-resisting system subject to special inspection for wind resistance:**

**Description of wind force-resisting components subject to special inspection for wind resistance:**

**Statement of Responsibility:**
The Contractor, Subcontractor, or Manufacturer responsible for the construction or fabrication of a system or component described above must submit a Statement of Responsibility.

## INTERIM REPORT OF SPECIAL INSPECTIONS

<table>
<tr><td colspan="8">City/County of:</td></tr>
<tr><td colspan="4" rowspan="2">Project Name/Address:</td><td colspan="4">Inspection Type(s) Coverage:</td></tr>
<tr><td colspan="2">☐ Continuous</td><td colspan="2">☐ Periodic</td></tr>
<tr><td colspan="8">Describe Inspections Made, Including Locations:</td></tr>
<tr><td colspan="8">Tests Made:</td></tr>
<tr><td rowspan="2">Total Inspection Time Each Day</td><td>Date:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Hours:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="8">List items requiring Special Inspection, and any discrepancies and corrections. If Engineer approval is required for any corrections, note this, and indicate that approval was obtained. Attach copies of all related correspondence.</td></tr>
<tr><td colspan="8">Comments:</td></tr>
</table>

To the best of my knowledge, work inspected was in accordance with the Contract Documents and applicable standards except as noted above.

Signed: _____ Date: _____

Print Full Name: _____ I.D.: _____

Phone Number: _____

**This report is to be submitted to the Building Official and the Engineer. A copy shall be maintained at the jobsite.**

**FINAL REPORT OF SPECIAL INSPECTIONS**

**PROJECT:** _____

**LOCATION:** _____

**PERMIT APPLICANT:** _____

**APPLICANT'S ADDRESS:** _____

_____

**ARCHITECT OF RECORD:** _____

**STRUCTURAL ENGINEER OF RECORD:** _____

**MECHANICAL ENGINEER OF RECORD:** _____

**ELECTRICAL ENGINEER OF RECORD:** _____

**REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE:** _____

To the best of my information, knowledge, and belief, Special Inspections required for this Project in accordance with Section 1704 of the International Building Code and any State or local amendments have been performed, and all work has been completed in accordance with the Contract Documents and all applicable standards, except as indicated.

The Special Inspection program does not relieve the Contractor of the obligation to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

This Final Report includes information submitted in previous Interim Reports numbered _____ to _____, as well as any Special Inspections, discrepancies, and corrections occurring since the last Interim Report, dated _____.

All items requiring Special Inspection are listed below. All inspections, tests, and similar services that were performed are listed and any discrepancies and corrections are indicated. If Engineer approval was required for any corrections, this is noted, and copies of all related correspondence are attached.

_____

_____

_____

_____

_____

_____

*(Attach 8 ½"x11" continuation sheet(s) if required to complete the description of corrections)*

**Prepared By:**

Special Inspector's Seal

_____
Special Inspection Agency:

_____
Type or print name

_____
Signature Date

## CONTRACTOR'S STATEMENT OF RESPONSIBILITY

The Contractor, Subcontractor, or Manufacturer responsible for the construction or fabrication of a main-wind- or seismic-force-resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections must submit this Statement of Responsibility prior to commencement of work on the system or component.

**Project:** _____

**Contractor's Name:** _____

**Address:** _____

**License No.:** _____

**Description of building systems and components included in Statement of Responsibility:**

_____

_____

_____

_____

_____

_____

_____

**Contractor's Acknowledgement of Special Requirements**

*I hereby acknowledge that I have received, read, and understand the Statement of Special Inspections and its requirements.*

_____

Name and Title (type or print)

_____ _____

Signature Date

## FABRICATOR'S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per Section 1704 of the International Building Code must submit this Fabricator's Certificate of Compliance at the completion of fabrication.

**Project:** _____

**Fabricator's Name:** _____

**Address:** _____

**Description of structural members and assemblies that have been fabricated:**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

*I hereby certify that items described above were fabricated on my premises in strict accordance with the Contract Documents and applicable standards.*

_____
Name and Title (type or print)

_____ _____
Signature Date

**Attach copy of Building Official's approval of fabricator as an Approved Fabricator.**

## NOTIFICATION OF FAILURE TO CORRECT DISCREPANCY

| |
|---|
| **City/County of:** |
| **Project Name/Address:** |
| **List discrepancies, proposed correction, and Contractor response. If Engineer approval is required for any corrections, note this, and indicate whether approval was obtained. Attach copies of all related correspondence.** |
| **Comments:** |

Signed: _____ Date: _____

Print Full Name: _____ I.D.: _____

Phone Number: _____

**This report is to be submitted to the Building Official, the Contractor, and the Engineer.**

**END OF SECTION**

**SECTION 01 51 00**

**TEMPORARY UTILITIES**

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall provide temporary utilities required for the Project and to complete the Work.

1. Make arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.

2. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges and connection fees, maintenance, relocation, and removal shall be borne by the Contractor at no additional cost to the Owner, except for utility company service charges for potable water usage, which will be paid by the Owner, when Contractor has connected to the Owner's existing water infrastructure at the Project site as described elsewhere herein.

3. Continuously maintain adequate utilities for all purposes during the Project until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.

4. Should Owner occupy part of the Project 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 between Owner and Contractor as mutually agreed to by the parties.

5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.

6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.

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

B. Provide the following temporary utilities:

1. Electricity and lighting

2. Telephone and communications

3. Heating

032619

4. Sanitary facilities

5. Water service

6. First-aid facilities

7. Fire protection

8. Ventilation

## 1.02 ADMINISTRATIVE REQUIREMENTS

A. Use of Owner's System

1. 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. Owner will pay all utility company service charges for Contractor's use of potable water.

2. Use of Permanent Utility Systems Provided under the Project

a. Permanent lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:

1) Obtain Owner's written permission to use permanent systems.

2) Permanent systems to be used for temporary utilities or temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls.

3) Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.

b. Do not use the following permanent facilities:

1) Telephone and communication facilities

2) Sanitary facilities

## 1.03 SYSTEM DESCRIPTION

A. Electricity and Lighting

1. Contractor shall provide electrical and lighting service for construction field offices, sheds, storage containers, etc. and as required for the Work.

2. General 120/240V Service Requirements

    a. Contractor shall provide 120/240V, single-phase, 3-wire temporary system for small power requirements and general lighting.

    b. Contractor shall provide main disconnect, overcurrent protection, meter outlet, branch circuit breakers, and wiring for temporary service to the Contractor's field office service connections. Contractor shall provide equipment and appurtenances in accordance with electricity service provider and applicable standards and codes

    c. Contractor shall register the 120/240V electrical service meter in the Contractor's name and shall be responsible for electrical charges at no additional cost to the Owner.

    d. Contractor shall provide electrical service other than 120/240V, single-phase, 3-wire service as required for the Work at the Contractor's own expense.

3. General Lighting Requirements

    a. Contractor shall provide a minimum of 10-foot-candles for enclosed and partially enclosed structures for performing the Work.

    b. Contractor shall provide a night lighting circuit for security. Light intensity shall be a minimum of 2-foot-candles.

4. Contractor shall energize the electrical system 15 minutes prior to and following regular workday hours at the Site from Monday through Friday, all inclusive.

5. Contractor shall energize the night lighting system at end of typical working day and de-energize at start of typical working day. System shall be continuously energized on Saturdays, Sundays, and holidays.

6. Contractor shall provide an independent grounding cable connected directly to the structure, building, and equipment for erection and fabrication by electrical welders. Grounding by adjacent conduit, piping, etc. shall be prohibited at the Site.

7. Contractor shall coordinate usage of temporary electrical system with Subcontractors, Suppliers, and Owner including the following:

    a. Usage is suitable for 120V, single-phase, 60 Hz operation with a maximum operating input of 1,500 volt-amperes.

    b. One unit connected to a single outlet.

    c. Restrict usage in case of overloading circuits to correct loading.

B. Telephone and Communications: Contractor shall provide temporary telephone and communications required for its operations at the Site and for summoning emergency medical assistance.

C. Heating

1. Contractor shall provide temporary heating, ventilation coverings and enclosures necessary to protect the Work and materials against wetness and temperature damage, to dry out the Work, and to facilitate the Work in structures.

2. Equipment, fuel, materials, personnel and methods used shall be adequate to maintain critical installation temperatures and ventilation of Work at all times in areas where necessary to perform the Work.

3. Enclosed structures shall have a minimum temperature of 50°F, unless otherwise specified, where Work is performed.

4. Contractor shall provide sufficient heat to maintain a minimum temperature of 65°F before and during application of interior finishing, painting, coating, etc.

5. Contractor shall replace any Work damaged by dampness or insufficient/abnormal heating at no cost to the Owner.

D. Sanitary Facilities

1. Contractor shall provide suitably enclosed chemical or self-contained toilets for Contractor's employees and visitors to the Site and in sufficient numbers. Location(s) of temporary toilets shall be acceptable to Owner and screened from public observation.

2. Contractor may discharge sanitary flows from their sanitary facilities to existing sanitary sewer manhole (SSMH) (201362) or SSMH (201003) (i.e., SSMH-3) identified on Drawings 01-C-102, 01-C-401, and 01-C-405. Note that there will be an interruption in the Contractor's ability to use the existing sanitary sewer system for discharging sanitary sewer flows during the time the downstream portion of this system is being modified (i.e., the existing sanitary sewer pipeline downstream of SSMH (201003) (i.e., SSMH-3) is being abandoned in place and a new sanitary sewer pipeline with manholes SSMH-1 and SSMH-2 is being constructed). Contractor shall be responsible for providing a temporary holding tank (if applicable) suitable for containing all sanitary flow to be discharged. Temporary holding tank shall include secondary containment and all temporary pumps, piping, fittings, valves, and appurtenances necessary to fill the tank. Contractor shall be responsible for providing a pump truck (if necessary) to discharge the contents of this temporary holding tank into the existing manhole on a regular basis. Contractor may also directly connect his sanitary facilities to the existing manhole for automatic discharge.

3. Facilities shall be maintained and provided in accordance with state of Georgia Labor Regulations and local ordinances. Contents shall be removed and disposed in accordance with local and state of Georgia regulations as required.

4. Contractor shall be prohibited from committing nuisances within, on, or in the vicinity of the Site.

E. Water Service

1. Contractor shall provide temporary water service for the Work including for construction purposes, sanitary facilities, fire protection, field office, and cleaning purposes.

2. Contractor may connect to the existing 6-inch-diameter potable water pipeline or the connected fire hydrant assembly (to be relocated) to the southeast of Dewatering Building No. 2 as shown on Drawing 01-C-102, 01-C-401, and 01-C-406 and use this pipeline or fire hydrant to supply potable water to the Contractor's and Engineer's field office trailer(s). Contractor shall be responsible for providing a proper backflow device, subject to approval by Owner and the Authority Having Jurisdiction, and all temporary piping, fittings, valves, and appurtenances necessary to connect to this pipeline; Contractor is not required to provide a water meter to measure their potable water usage.

3. Contractor shall provide potable water for Contractor's personnel either by portable containers or drinking fountains. Note that no reuse water is currently available at the Site; however, after the Final Effluent Water Pump Station is constructed and placed into service, the Contractor may utilize it as a source of non-potable water.

4. Contractor shall provide temporary hose bibs, hoses, and watertight barrels for the distribution of water.

5. Contractor shall provide freeze protection for water service.

6. The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the Owner. For each such connection made, the Contractor shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.

7. Removal of Water Connections: Before Final Acceptance of the Work, all temporary water connections and piping installed by the Contractor shall be entirely removed and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Owner, the Engineer's Resident Project Representative, and to the agency owning the affected utility.

F. First-Aid Facilities

1. Contractor shall provide temporary first-aid stations at or immediately adjacent to the Site's major work areas. Contractor shall provide temporary first-aid stations inside its temporary field office. Locations of first-aid stations shall be determined by Contractor's safety representative.

2. Contractor shall 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 31 19 – Project Meetings.

G. Fire Protection

1. Contractor shall comply with NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations and requirements of fire marshals and authorities having jurisdiction at the Site.

2. Contractor shall provide temporary fire exits, fire extinguishers, hoses and safety devices as required by authorities having jurisdiction.

3. Contractor shall notify Engineer, Owner, and fire marshals in the event of fire at the Site including, but not limited to, fuel tanks and similar hazardous utilities and devices. Contractor shall cooperate with owner of fuel tank and utilities to prevent occurrence of fire or explosion.

4. Contractor shall perform safety precautions and comply with fire marshal's instructions in the event of fire.

H. Temporary Ventilation: Contractor shall provide and maintain adequate ventilation for a safe working environment in confined spaces. The Contractor shall follow the applicable requirements of the OSHA Standards for Construction and NIOSH Publications for working in confined spaces. In addition, forced air ventilation shall be provided for the curing of installed materials, humidity control, and the prevention of hazardous accumulations of dust, gases, or vapors.

## PART 2 – PRODUCTS

### 2.01 EQUIPMENT

A. Materials and equipment for temporary systems may be new or used but shall be adequate for purposes intended, shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities including piping, wiring, and controls.

C. Electrical System Requirements: System shall consist of wiring, switches, insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts and fuses as required for completion of the Work.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Install temporary facilities in a 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 Contract, the work under other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

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.

### 3.02 MAINTENANCE

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 workday, 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.

D. Contractor shall replace broken and burned out lamps, blown fuses, and damaged wiring and appurtenances as required to maintain adequate and safe operating conditions.

E. Contractor shall permit Subcontractors and others at a mutually agreed arrangement to use temporary electrical system that meet the following requirements:

1. Equipment is suitable for 120V, single-phase, 60 Hz operation.

2. Operating input does not exceed 1,500 volt-amperes.

3. Single piece of equipment is connected to one outlet.

4. Contractor shall restrict use of equipment as required to prevent overloading circuits.

## 3.03 CLOSEOUT ACTIVITES

A. Completely remove temporary utilities, 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. Contractor is responsible for and shall return to original condition those portions of permanent electric system used in completing the Work.

C. 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.

D. When permanent utilities and systems were used for temporary utilities, upon Substantial Completion, replace all consumables such as filters and light bulbs and parts used during the Work.

**END OF SECTION**

## SECTION 01 52 00
## CONSTRUCTION FACILITIES

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall provide construction facilities for performance of the Work, including the following:

1. Contractor's field office, sheds, and storage containers, which shall be erected within the 30-day period before Contractor begins actual construction activities on the Project site

2. Engineer's field office provided with specified temporary utility services, which shall be erected within the 30-day period before Contractor begins actual construction activities on the Project site

3. Project sign and panel, which shall be erected within 21 days of Notice to Proceed on the Project

B. Contractor shall be responsible for obtaining applicable building permits from Cherokee County for all temporary facilities for construction.

### 1.02 FACILITY DESCRIPTION

A. Contractor's Field Office, Sheds, and Storage

1. Contractor shall provide and maintain a field office at the Site, including temporary utility services specified.

2. Size and Furnishings: As required by Contractor

3. Features: Exterior Contractor identification sign, night lighting for security, and temporary utilities specified in Section 01 51 00 – Temporary Utilities

4. Location: As shown on the Contract Documents

5. Contractor shall provide and maintain one set of Contract Documents, latest approved shop drawings, Field Orders, Requests for Interpretation, Work Change Directives, Requests for Proposal, Change Proposals, Change Orders, and other pertinent Project-related correspondence.

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B. Engineer's Field Office

1. Contractor shall provide Engineer's field office for Resident Project Representative (RPR).

2. Requirements

a. Separate structure with a minimum of 720 SF of floor area

b. Separate covered porch with a minimum of 72 SF of floor area at main entrance to structure. Cover shall have separate roof and rainproof seal to main structure.

c. Stairways for access

d. Proper foundations, proper surface drainage, and connections for utility services

e. Minimum 100 SF of area of gravel or crushed rock base, minimum depth of 4 inches, with geotextile fabric placed over the subgrade at each entrance. Keep area free of weeds, grass, and mud.

f. Doors and windows provided with locking devices and hardware to prevent unauthorized entry. Door keys shall be provided to Engineer for the duration of the Project. Door keys will be returned to Contractor following completion of Project.

g. Functional, totally enclosed restroom with mirror in compliance with requirements of state of Georgia and local health authorities

h. Minimum Temporary Utilities Requirements

1) Heating: Maintain 68°F in winter.

2) Cooling: Maintain 75°F in summer.

3) Interior Electrical Outlets: Minimum one outlet per wall of structure

4) Electrical Service: Adequate temporary electrical service for fully functional field office

5) Individual, direct line telephone service with equipment for up to four persons

6) Individual, direct high-speed internet service (DSL or cable), at minimum 100 Mbps up and down Internet speed, with hardwired networking up to four persons and Wi-Fi for exclusive use by the Engineer

7) Potable water service to water closet and lavatory

8) Interior and exterior lighting that conforms to Section 01 51 00 – Temporary Utilities and as specified in this Section

3. Furnishings for Engineer's Field Office

| Quantity | Description |
|---|---|
| 2 | Flat top desk, 2.5 x 5 feet, with drawers at each end |
| 1 | Plywood drawing table, 3 x 6 feet tilt top with drafting stool |
| 12 | Straight chairs |
| 2 | Four-drawer, legal size steel filing cabinets with lock and key (HON 210P Series full-suspension files) |
| 1 | 23-gallon metal or heavy-duty plastic waste baskets with lids |
| 3 | 28-quart metal or heavy-duty plastic waste baskets |
| 1 | Hanging drawing racks with appurtenances |
| 1 | Coat hook |
| 2 | Wall-mounted fire extinguishers |
| 2 | Bookcase with 4 shelves, 3 feet wide |
| 3 | Metal/plastic office folding tables, 30 x 60 inches (minimum) |
| 1 | Metal/plastic office folding table, 30 x 96 inches (minimum) |
| 1 | Steel storage cabinets (72 inches high x 36 inches wide x 24 inches deep) with four adjustable shelves and locks |
| 1 | First aid cabinet (conforms with OSHA requirements for construction site of up to five people) |
| 2 | Tilt/swivel type desk chairs |
| 1 | 4-CF capacity refrigerator |
| 1 | 1.4-CF countertop microwave with double-oven cart |
| 1 | Laser copying/printing/scanner/facsimile machine with local service contract (printing/scanning in full color up to 11-inch x 17-inch paper size) |
| 1 | Office hard drive (1 TB minimum) and router networked for up to four personnel with high speed internet, wireless network, and 4-in-1 printer |
| 2 | 36-inch x 48-inch dry erase white board with eraser and five different colored markers (one in each office) |
| 1 | Water cooler with filter connected to potable water system |

| Quantity | Description |
|---|---|
| 1 | Outdoor minimum-maximum thermometer with range of -40 to 120 degrees Fahrenheit and reset provisions |
| 1 | Rain gauge |

4. Exterior Engineer Identification Sign: 24-inch x 36-inch plywood sign painted white with blue, centered 3-inch-high lettering with the following inscription:

   Field Office

   Hazen and Sawyer

   [Office Location]

5. Location: As shown on the Contract Documents.

6. Consumables: Contractor shall provide consumables and supplies for the Engineer's Field Office including, but not limited to, waste basket heavy-duty liners, floor entry mats, mud-cleaning brushes, paper towels, toilet paper, printer ink, hand sanitizer, water cups, water filters, soap, copying machine paper (all sizes), etc. for the duration of the Contract.

7. Cleaning Services: Contractor shall provide qualified, professional cleaning services to clean Engineer's field office a minimum of two times per week for the duration of the Project.

8. Contractor shall respond and address maintenance issues that occur at the Engineer's field office with 24 hours notification.

C. Project Identification Sign

1. Contractor shall provide in accordance with this Section.

2. Contractor shall maintain project identification sign for the duration of the Contract.

3. Contractor shall remove and dispose of project identification sign at the completion of the Project when notified by the Engineer.

4. Contractor shall not receive additional payment for deterioration or replacement of names and other pertinent sign information throughout the duration of the Project.

## 1.03 SUBMITTALS

A. Action/Informational Submittals: Project identification sign layout, details, and materials of construction

## PART 2 – PRODUCTS

### 2.01 COMPONENTS

A. Project Identification Sign

1. Sign Panel: 3/4-inch-thick (minimum) marine plywood rabbeted in a 2-inch x 4-inch wood frame. Panel shall be fastened to sign supports with six 3/8-inch-diameter galvanized bolts, nuts and washers (minimum).

2. Sign Supports: Two 4-inch x 4-inch treated wood posts

3. Fasteners and Hardware: Galvanized

4. Painting: Supports, trim and back of sign panel shall be painted with two coats (minimum) of same paint for sign face. Paint shall be exterior-grade paint, suitable for wood application and in accordance with Section 09 90 00 – Painting.

5. Wording, Colors, and Arrangement: Cherokee County Water & Sewerage Authority; Fitzgerald Creek WPCP Thermal Dryer Facility; Hazen and Sawyer

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Install temporary field offices and storage facilities on proper foundations and provide connections for utility services.

1. Secure portable or mobile buildings when used.

2. Provide steps and landings at entrance doors.

3. Provide tie-downs for 100-mph wind gusts.

B. Locate construction facilities at locations within the area designated by the Engineer on the Drawings.

### 3.02 REMOVAL

A. Remove temporary field offices and utilities at Final Completion of Project or as directed by the Engineer.

B. Remove foundations and debris and grade site to required elevations and clean areas. At a minimum, restore area to the condition it was in at the beginning of the Project and re-grass/re-stone as required.

C. Furnishings for the Engineer's field office shall remain property of the Contractor.

**END OF SECTION**

## SECTION 01 55 00
## CONTRACTOR ACCESS AND PARKING

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide and maintain temporary laydown and employee parking areas and appurtenances required during the Project for use by Contractor, Subcontractors employed on the Project, Owner, and emergency vehicles as shown on the Drawings.

2. Laydown and employee parking areas shall be designed and maintained by Contractor and shall be fully passable to vehicles in all weather conditions.

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Access Roads

1. Contractor shall construct and maintain such temporary access roads as required to perform the Work.

2. Contractor shall construct access roads, where possible, in locations over the areas of future road systems.

3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for use and convenience.

a. Contractor shall submit written documentation to the Engineer for Contractor secured easements across privately held property.

b. Easement agreements shall specify terms and conditions of use and provisions for restoration.

c. Written release from property owner certifying that terms of the easement agreement have been complied with by the Contractor shall be furnished to the Engineer prior to final payment.

B. Use of Existing Access Roads

1. Contractor will be allowed to use Owner's existing roads as shown on the Drawings.

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2. Prevent interference with traffic on existing roads and parking areas. At all times, keep access roads and entrances serving the Site clear and available to Owner, Owner's 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 caused by Contractor's operations over existing roads and parking areas.

4. Schedule deliveries to minimize use of driveways and Site entrances.

5. Contractor shall suitably maintain existing access roads at Contractor's expense for the duration of the Contract Times.

C. Contractor Parking Areas

1. Contractor's employee vehicles shall park in area(s) designated by Owner or as shown on the Drawings.

2. Contractor shall construct and maintain parking area at the Site.

D. State and Local Regulations

1. Contractor shall obtain and pay all costs associated with bonds required by authorized entity (i.e., GDOT) for the use of GDOT-maintained roads.

2. Contractor shall obey traffic laws and comply with requirements, rules and regulations of the authorized entity (i.e., GDOT), including local authorities having jurisdiction, to maintain warning signs, lights, barriers, etc. for the protection of traffic on public roadways.

E. Site Security

1. Contractor shall safely guard all the Work, the Site, products, equipment, and property from loss, theft, damage, and vandalism until Substantial Completion. 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 Work.

2. Employ watchmen as required to provide required security and prevent unauthorized entry.

3. Costs for security required under this Section shall be paid by Contractor.

4. Make no claim against Owner for damage resulting from trespass.

5. Pay full compensation for, or repair or replace, damage to property of Owner and others arising from failure to furnish adequate security.

6. Provide temporary fencing in accordance with the Contract Documents.

7. Security requirements specified in this Section shall begin as soon as the Contractor delivers materials to the Site and/or begins work and shall continue until the date of Final Completion.

8. Procedures

    a. Contractor shall conform to Owner's security procedures and access restrictions at Site throughout entire Project.

    b. Contractor, including Subcontractors and Suppliers, shall comply with the following:

        1) Parking: Do not park outside of designated Contractor parking area, which is shown on the Drawings. Prepare and maintain parking area as required. Personal vehicles are not allowed outside Contractor parking area.

9. Contractor shall provide and maintain temporary security fencing if existing security fencing or barriers are breached or temporarily removed for the Project at no additional cost to the Owner. Temporary security fencing shall be equal to existing, unless otherwise specified, and provided and maintained in a manner satisfactory to Engineer and Owner.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Contractor shall determine if and where temporary fencing is necessary, unless existing security fencing is damaged, which will be determined by Engineer and Owner.

B. Install temporary fencing used for Site security in accordance with the Contract Documents and fence manufacturer's instructions. Provide temporary fencing for Site security so that integrity of Site security is maintained throughout the Project.

C. Maintain temporary fencing. Repair damage to temporary fencing and replace fencing when required to maintain Site security.

D. Remove temporary fencing when permanent Site security fencing is in place and fully functional or when otherwise directed by Owner or Engineer.

**END OF SECTION**

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# SECTION 01 57 00
# TEMPORARY CONTROLS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.

B. Maintain controls until no longer required.

C. Temporary controls include, but are not limited to, the following:

1. Dust control

2. Noise controls

3. Pest and rodent control

4. Pollution control

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 DUST CONTROL

A. Contractor shall take measures to control dust from their operations and prevent spillage of excavated materials on public roads.

B. Contractor shall remove spillage of excavated materials, debris and dust from public roads by methods approved by Engineer.

C. Contractor shall provide temporary dust-proof partitions where required to protect unaltered portions of existing structures and facilities and as directed by Engineer or Owner. Temporary partitions shall be provided to protect equipment and material where demolition work occurs and shall consist of the following:

1. Wood studs with plywood on both sides and extending from floor to ceiling

2. Closure plate at floor and ceiling

3. One door (minimum) with hardware

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D. Contractor shall refer to applicable sections of local and state regulations on dust control for additional guidance.

1. Contractor shall apply water at locations, quantities, and frequencies required by Engineer to control dust for nuisance prevention to Owner, Engineer, and properties in the vicinity of the Site.

2. Dust control and cleaning measures shall be provided at no additional cost to the Owner.

## 3.02 NOISE CONTROL

A. Contractor's vehicles and equipment shall minimize noise emissions to greatest degree practicable. Provide mufflers, silencers, and sound barriers when necessary.

B. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.

C. Noise emissions shall not interfere with the work of Owner or others.

D. When activities that may produce noise emissions outside of normal working hours or noises louder than typical plant operations are warranted, notify Owner 7 calendar days in advance of the associated activities for coordination with surrounding residents.

## 3.03 PEST AND RODENT CONTROL

A. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.

B. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.

C. In accordance with laws and regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

## 3.04 POLLUTION CONTROL

A. General

1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.

2. Equipment used during construction shall comply with Laws and Regulations.

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.

C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. 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.

D. Atmospheric Pollutants

1. Provide 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 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.

**END OF SECTION**

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# SECTION 01 61 00
# PRODUCT REQUIREMENTS AND OPTIONS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Common requirements for products

2. Contractor's options for selecting products

3. Requirements for consideration of "or equal" products

4. Warranty requirements of products

### 1.02 REFERENCES

A. Definitions

1. "Products" includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include Owner-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

2. "Special Warranties" includes additions or modifications to standard warranty requirements specified in the Contract Documents.

### 1.03 SUBMITTALS

A. Warranty Log Book

1. Submit warranty log book prepared specifically for this Project. Submittal shall include a summary listing of all equipment and material warranties furnished in the Contract, date received, and start/end date of warranty period. Individual warranty documentation shall be provided in the submittal.

2. Submit prior to submittal of final Application for Payment.

B. Patent Documentation: Submit licensing arrangement and agreement documentation.

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## 1.04 REQUIREMENT

A. Common Products

1. Provide products that have not been previously incorporated into another project or facility unless otherwise indicated in the Contract Documents.

2. To the extent possible, provide products of the same generic kind from a single source.

3. Provide products complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.

4. Standard Products: When available and unless custom or nonstandard options are specified or indicated, provide standard products of types that have been produced and used successfully in similar situations on other projects.

5. Visual Matching: Where required in the Contract Documents, provide products that match referenced existing construction, approved mock-ups, or approved sample, as determined by Engineer.

6. Where the Contract Documents include the phrase “as selected” for product color, finish pattern, option, or similar phrase, provide products selected by Engineer as follows:

   a. Standard Range: Where the Contract Documents include the phrase “standard range of colors, patterns, textures” or similar, provide color, pattern, density, and/or texture selected by Engineer from manufacturer’s product line that does not include premium items.

   b. Full Range: Where the Contract Documents include the phrase “full range of colors, patterns, textures” or similar, Engineer will select color, pattern, density, and/or texture from manufacturer’s entire product line, including standard and premium items.

B. Product Compatibility

1. Similar products by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents or approved by Engineer.

2. Provide products compatible with products previously selected or installed on the Project.

C. Product Options

1. For products specified only by reference standard or description, without reference to Supplier, provide products meeting that standard, by a Supplier or from a source that complies with the Contract Documents.

2. For products specified by naming one or more products or Suppliers, provide the named products that comply with the Contract Documents, unless an “or equal” or substitute product is approved by Engineer.

3. For products specified by naming one or more products or Suppliers and the term “or equal”, when Contractor proposes a product or Supplier as an “or equal”, submit to Engineer a request for approval of an “or equal” product or Supplier.

4. For products specified by naming only one product or manufacturer and followed by words indicating that no substitution is allowed, there is no option and no substitution will be allowed.

D. Concerning Patents

1. Owner shall be provided a guarantee by Contractor and equipment Supplier that equipment and material furnished in accordance with the Contract Documents is not the subject of patent litigation.

2. Patent litigation or controversy shall include, but not limited to, the following:

   a. Actual furnished equipment and material that is subject or could be subject to patent litigation or is known to infringe on a patent

   b. Furnished equipment and material that may result in a process that use of equipment and material in a manner that infringes upon or violates a patent

3. When patent infringement may occur, Contractor and Supplier shall submit license arrangements among parties, including Contractor, Supplier, and patent owner (controller of patent) at a minimum, which shall permit use of equipment and material as specified in the Contract Documents.

4. Supplier shall indemnify and hold harmless Owner and Engineer against all claims, costs, losses, and damages arising out of or relating to any infringement or patent rights or copyrights incident to the use of equipment and material specified in the Contract Documents and as required in General Conditions and as modified in the Supplemental Conditions.

E. “Or Equal” Products

1. For proposed products not named in the Contract Documents and considered as an “or equal” as defined in the General Conditions, Contractor shall request in

writing Engineer's approval of the "or equal". Request for approval of an "or equal" product shall accompany the shop drawing or product data submittal for the proposed product and shall include:

a. Contractor's request that the proposed product be considered as an "or equal" in accordance with the General Conditions, accompanied by Contractor's certifications required in the General Conditions

b. Documentation adequate to demonstrate that proposed product does not require revisions to the Contract Documents, that proposed product is consistent with the Contract Documents, and that proposed product will produce results and performance required in the Contract Documents, and that proposed product is compatible with other portions of the Work

c. Detailed comparison of significant qualities of proposed product with the products and manufacturers named in the Contract Documents, including attributes such as performance, weight, size, durability, visual effect, performance, and specific features and requirements shown or indicated.

d. Evidence that proposed product manufacturer will furnish warranty equal to or better than specified, if any

e. List of similar installations for completed projects with project names and physical addresses of installation along with the names, telephone numbers, email addresses and physical address of design professionals and owners associated with the referenced installation, if requested

f. Samples, if requested

g. Other information requested by Engineer

## 1.05 WARRANTY

A. Warranties specified for products shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the required correction period. Disclaimers and limitations in specific product warranties do not limit Contractor's general warranty and guarantee.

1. Product manufacturer's warranty is preprinted written warranty published by product manufacturer and specifically endorsed by product manufacturer to Owner.

2. Equipment and material shall be guaranteed to be free from defects in workmanship, design, and/or materials for a period of 1 year unless otherwise specified in the individual Specification Section for a Special Warranty.

3. Warranty period shall start on the date of the particular equipment and material is substantially complete, which includes requirements specified in Section 01 75 00 – Checkout and Startup Procedures for start-up certification and specified elsewhere in the Contract Documents.

4. Warranty requirements may be added to or modified in the individual Specification Sections. Special warranty is written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by product manufacturer's warranty or to provide increased rights to Owner.

5. Special warranty information, if any, will be located in the Specification Section for that product.

B. Requirements for Special Warranties: Provide written special warranty document that contains appropriate terms and identification, ready for execution by product manufacturer and Owner. Submit draft warranty with submittals required for product.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed by product manufacturer and other parties as appropriate.

2. Specified Form: When specified forms are included in the Contract Documents, prepare written document, properly executed by product manufacturer and Owner, using appropriate form.

3. Refer to Specifications for content and requirements for submitting special warranties.

C. Submit product manufacturer's warranties and special warranties as submittals in accordance with Schedule of Submittals accepted by Engineer.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 01 65 00
## PRODUCT DELIVERY REQUIREMENTS

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. General requirements for preparing for shipping, delivering, and handling materials and equipment

B. Contractor shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.

### 1.02 SUBMITTALS

A. Refer to individual Specification Sections for submittal requirements relative to delivery and handling of materials and equipment.

### 1.03 SHIPMENT REQUIREMENTS

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. Advance Notice of Shipments

1. Keep Engineer informed of delivery of all materials and equipment to be incorporated in the Work.

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E. 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, 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.

## 1.04 DELIVERY REQUIREMENTS

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 other contractors and Owner

b. Owner's operations and maintenance

c. Storage space limitations

d. Availability of equipment and personnel for handling materials and equipment

e. 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 clearly marked.

2. Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.

3. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number.

4. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and additional costs, if incurred.

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, allow easy accumulation of parts, and facilitate assembly.

D. Inspection of Deliveries

1. Immediately upon delivery, Contractor shall 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; 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, and/or defective materials and equipment are delivered and advise Engineer of the associated impact on the Progress Schedule.

## 1.05 HANDLING 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 PROTECTION REQUIREMENTS

### PART 1 – GENERAL

### 1.01 SUMMARY

A. General requirements of storing and protecting equipment and materials

### 1.02 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. 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 shall be as 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 ambient temperatures. 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.

E. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

F. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer, directed by Engineer, 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.

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I. Contractor shall not store unnecessary equipment and materials at the Site.

J. Contractor shall prevent structures from being loaded with a weight that endangers its security and/or safety of persons.

K. Stored equipment and materials shall not be placed within 10 feet of fire hydrants.

L. Gutters, drainage channels and inlets shall be kept unobstructed at all times.

## 1.03 PROTECTION

A. Contractor shall provide temporary storage containers/facilities, if required, to protect equipment and materials at the Site.

B. 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.

C. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.

D. 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.

## 1.04 SPECIFIC STORAGE REQUIREMENTS

A. Uncovered

1. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:

    a. Piping, except polyvinyl chloride (PVC) or chlorinated PVC (CPVC) pipe

B. Covered

1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:

    a. Grout and mortar materials

    b. Rough lumber

    c. PVC and CPVC pipe

2. Tie down covers with rope and slope covering to prevent accumulation of water.

C. Fully Protected

1. All materials and equipment not named as uncovered or covered in this Section shall be stored on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:

    a. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.

    b. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.

    c. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.

    d. Maintain humidity at levels recommended by manufacturers of electrical and electronic equipment.

    e. Energize space heaters for electrical equipment and material.

D. Maintenance of Storage: 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

## 1.05 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**

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# SECTION 01 71 23
# FIELD ENGINEERING

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall provide field engineering and professional services of the types indicated for the Project, including:

1. Furnishing civil, structural, and other professional engineering services specified or required to execute Contractor's construction methods

2. Developing and making all detail surveys and measurements required for construction

3. Keeping a transit, theodolite, or total station (theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices at the Project Site at all times and having a skilled instrument person available when necessary for laying out the items of the Work.

4. 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

5. Rectifying all items of the Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments

6. Providing such facilities and assistance necessary for Engineer to check lines and grade points placed by Contractor

B. Related Sections

1. Section 01 25 00 – Substitution Procedures

2. Section 01 26 00 – Contract Modification Procedures

3. Section 01 61 00 – Product Requirements and Options

4. Section 01 78 39 – Project Record Documents

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## 1.02 ADMINISTRATIVE REQUIREMENTS

A. Departures from Drawings

1. Drawings show the extent and arrangement of the Work.

2. Contractor shall notify Engineer of departures from the Drawings that the Contractor deems required for incorporation of the Work at the Project Site in accordance with Section 01 26 00 – Contract Modification Procedures.

3. Contractor shall provide field engineering services for equipment and materials that require modifications to existing structures, auxiliary equipment, piping, and electrical controls that are not indicated for modifications in the Contract Documents.

B. Structural Design Criteria

1. Structural design in the Contract Documents of facilities, structures, supports, roofs and floors are based on typical weights for equipment and materials and design criteria in the Contract Documents.

2. Contractor shall notify Engineer of equipment and materials to be considered as substitutions and “or equals” in accordance with Section 01 25 00 – Substitution Procedures and Section 01 61 00 – Product Requirements and Options.

3. Contractor shall provide services for incorporation of equipment and materials that exceed structural design criteria at no additional cost to Owner.

## 1.03 SERVICES AND RESPONSIBILITIES

A. Contractor’s Field Engineer

1. Contractor shall employ and retain a field engineer at the Site capable of performing field engineering tasks required including:

a. Provide reports to Engineer on the Work.

b. Check formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping and other equipment and materials for conformance with Contract Documents.

c. Maintain field office files and drawings, record documents, and coordination with Subcontractors.

d. Prepare layout and coordination drawings for construction operations.

e. Check and coordinate items of the Work for conflicts, interferences, and discrepancies with notification to Engineer.

f. Cooperate with Engineer and Owner in observing performance of the Work and field inspections.

g. Review and coordinate items of the Work with shop drawings and other submittals.

B. Contractor’s Surveyor

1. Contractor shall employ or retain the services, as needed at the Project Site, of a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Surveyor's tasks include, but are not necessarily limited to, the following:

a. Providing required surveying equipment, including transit or theodolite, level, stakes, and surveying accessories.

b. Establishing required lines for constructing all facilities, structures, pipelines, and site improvements.

c. Preparing and maintaining professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the Work.

d. Complying with requirements of the Contract Documents relative to surveying and related work.

## 1.04 SUBMITTALS

A. Action/Informational Submittals

1. Surveying

a. Plan for conducting survey work, submitted 10 days prior to beginning of survey work

b. Field books after completing survey work

c. Certified survey in accordance with this Section

2. Certificates: Signed by Contractor or Contractor’s surveyor certifying elevations and locations of items of the Work are in conformance with Contract Documents, with explanations of deviations

3. Qualification Statements: Contractor’s surveyor

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 SURVEYING

A. Contractor shall establish baselines for location of equipment, materials and structures of the Work with benchmarks and batter boards adjacent to the items of the Work.

B. Contractor shall provide detailed surveys necessary for the Work including, but not limited to, slope stakes, batter boards, working points, lines and elevations.

C. Specific Surveying

1. Contractor shall have weirs surveyed by professional, licensed surveyor.

2. Contractor shall adjust weirs within a tolerance of +/-0.05 inch of elevations shown on the Contract Documents.

3. Surveyed points for weirs shall be no greater than 10 feet spacing and no less than two points per section of weir plate.

### 3.02 CLOSEOUT ACTIVITES

A. Contractor shall provide Project record documents for field engineering and surveying in accordance with Section 01 78 39 – Project Record Documents.

B. Contractor shall provide certified weir elevation survey report in accordance with the requirements specified in this Section.

### 3.03 PROTECTION

A. Contractor shall preserve and protect benchmarks, reference points and stakes. Contractor shall re-establish damaged, destroyed, or lost benchmarks, reference points and stakes. Contractor shall remove and re-install equipment and material installed based on Contractor-established benchmarks, reference points and stakes that have been damaged, destroyed, or lost at no additional cost to Owner.

B. Contractor shall preserve and protect existing and new control points, property markers and monuments during construction of the Work. Contractor shall establish and replace damaged or lost control points, property markers and monuments due to Contractor's construction activities at no cost to the Owner. Contractor shall provide computations and calculations to establish location of replacement items of the Work.

**END OF SECTION**

## SECTION 01 71 33
## PROTECTION OF WORK AND PROPERTY

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Protection of existing utilities and structures
2. Protection of installed equipment and materials
3. Protection during inclement weather
4. Reporting of accidents
5. Barricades and warning signals

B. Contractor shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and this Section.

C. To prevent damage, injury, or loss, Contractor's actions shall include the following:

1. 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 or utility companies
2. Providing suitable storage facilities for equipment and materials subject to damage or degradation by exposure to weather, theft, breakage, or other cause
3. 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
4. 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

D. 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 restored by Contractor at their expense to condition equal to that existing before damage was done.

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E. Contractor shall comply with safety regulations required by Owner or authorities having jurisdiction. Contractor shall comply with and correct unsafe conditions created or caused by Contractor's personnel. In the event Contractor fails to comply, Owner receives the right to take necessary measures to correct conditions or practices for reimbursement by Contractor.

## 1.02 REFERENCES

A. Definitions

1. "Existing utilities" shall refer to both publicly owned and privately owned utilities such as, but not limited to, electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

2. "Surface structures" shall refer to existing buildings, structures, and other facilities at or above ground surface, including their foundations or any extension below ground surface. Surface structures shall include, but not be limited to, buildings, tanks, walls, channels, open drainage, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.

## 1.03 SITE CONDITIONS

A. Locations of Existing Utilities and Structures

1. Contractor shall confirm and verify locations of existing utilities and structures at the Site prior to commencing the Work.

2. Contractor shall notify and obtain approval from authority having jurisdiction prior to performing the Work in the vicinity of the existing utilities and structures.

# PART 2 – PRODUCTS (NOT USED)

# PART 3 – EXECUTION

## 3.01 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. General

1. Contractor shall satisfy Engineer that methods and procedures for protection have been approved by authorities having jurisdiction prior to proceeding with the Work.

2. Contractor shall provide temporary support and protection, as required, to existing utilities and structures during the Work, including support of excavation.

    a. Where the Contractor is required to temporarily support or otherwise protect any existing utility lines or appurtenant structures during the Work, such support and protection shall be provided by the Contractor to ensure integrity of the utility or structure is not compromised. All such work shall be performed in a manner satisfactory to the Owner and Engineer and in accordance with the requirements of the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the Owner and Engineer may, at their discretion, have the respective authority to provide such support or protection as may be necessary to ensure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

3. Contractor shall be responsible for costs incurred for temporary support or protection provided by a third-party or authority having jurisdiction to ensure safety of the existing utility, Owner, and public and private parties.

B. Existing Buried Utilities

1. Contractor shall perform field investigations to identify conflicts or interferences between existing utilities and utility work prior to excavation work.

    a. Investigation of conflicts and interferences shall be performed on Site locations, elevations, slopes, etc. of the existing utilities determined during the field investigations.

    b. Contractor shall notify Engineer and Owner in writing of identified conflicts or interferences. Contractor shall not proceed with the Work until written authorization is provided by the Engineer.

    c. Identified conflicts and interferences shall be handled in accordance with the Contract Documents. If required, potential modification to the Contract Documents shall be performed in accordance with Section 01 26 00 – Contract Modification Procedures.

2. Contractor shall perform the Work to prevent disruption of existing service and damage to existing utilities.

    a. Temporary connections shall be provided, as required, to provide uninterrupted service of existing utilities.

    b. Contractor shall repair damage to existing utilities as directed by the Engineer or the authority having jurisdiction at Contractor’s own expense.

c. Contractor shall be responsible for damages and repair costs to the authority having jurisdiction if third-party or authority having jurisdiction personnel repair damaged existing utilities.

C. Protection of Existing Structures

1. Contractor shall sustain existing surface structures in existing place and protect from direct or indirect injury 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. Contractor shall bear all risks attending the presence or proximity of all surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents.

3. Contractor shall be responsible for damage and expense for direct or indirect injury caused by their Work to structures and facilities.

4. Contractor shall repair immediately damage caused by their Work to the satisfaction of owner of damaged structure or facility and at no cost to the Owner.

5. Contractor shall provide temporary weather protection for existing structures and buildings where exterior walls or roofs are modified or disturbed in the Work. Contractor shall be responsible for damages due to inadequate protection of existing structures and building.

D. Relocation of Surface Structures: 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 original condition at Contractor's expense.

E. Specific Requirements: See Drawings for additional requirements.

## 3.02 PROTECTION OF INSTALLED EQUIPMENT AND MATERIALS

A. Contractor shall protect installed equipment and materials to prevent damage, injury or loss from subsequent operations. Remove protection facilities when no longer needed prior to completion of the Work.

B. Control traffic to prevent damage to equipment, materials, and surfaces.

C. Coverings: Provide coverings to protect materials and equipment from damage.

## 3.03 PROTECTION DURING INCLEMENT WEATHER

A. Contractor shall not perform work during inclement or unsuitable weather that will affect the quality of the completed Work.

B. Contractor shall take necessary precautions in the event of impending inclement weather to protect equipment, materials and Work from damage or deterioration due to floods, driving rain, wind, or snow storms.

1. Owner reserves the right to require additional protection measures beyond Contractor's proposed protection measures to protect the Work.

2. Contractor shall not claim additional compensation for additional protection measures required by Owner nor for damages to equipment, material, or Work due to the inclement weather.

C. When directed by Engineer, Contractor shall stop work and protect the Work by protective covering during rain storms for, but not limited to, the following:

1. Concrete mixing and placement

2. Paving placement

3. Masonry installation

4. Buried piping, valve and appurtenance installation

5. Additional inclement weather requirements and limitations are specified in individual Specification Sections.

## 3.04 REPORTING OF ACCIDENTS

A. Contractor shall immediately report in writing to Engineer and Owner accidents out of, or in conjunction with, the performance of the Work.

1. Accident reporting shall include accidents that occur on Site and adjacent to Site that cause death, personal injury, or property damage.

2. Written report shall provide full details and witness statements.

3. If claim is made against Contractor, Supplier, or Subcontractor due to accident, Contractor shall promptly report facts in writing to Engineer and Owner, with full account of the claim.

B. Contractor shall immediately report death, serious injury, or serious damage caused by telephone or messenger to Engineer and Owner.

**END OF SECTION**

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## SECTION 01 73 00
## DEMOLITION AND EXECUTION OF WORK

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for execution of the Work as specified in this Section, including the following:

    a. Construction Electronic Documentation

    b. Demolition

    c. Cutting and Coring

    d. Patching

    e. Installation

2. Requirements for demolition, removal and disposal of existing buildings, structures, pavement, curbs, and sidewalks and electrical, plumbing, heating and ventilation equipment and materials as indicated in the Contract Documents for demolition.

3. General requirements for installation of equipment and material. Additional installation requirements are included in the individual Specification Sections.

4. General requirements for connections to existing facilities. Requirements for tie-ins and shutdowns necessary to complete the Work are included in Section 01 14 00 – Coordination with Owner's Operations.

    a. 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.

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5. Requirements for cutting and coring, and rough and finish patching of holes and openings in existing construction. 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 work

    d. Connect to completed work not performed in proper sequence

    e. Remove or relocate existing utilities and pipes that obstruct the Work in locations where connections must be made

    f. Make connections or alterations to existing or new facilities

B. Related Sections

1. Section 01 14 00 – Coordination with Owner's Operations

2. Section 01 51 00 – Temporary Utilities

3. Section 01 57 00 – Temporary Controls

4. Section 01 61 00 – Product Requirements and Options

5. Section 01 66 00 – Product Storage and Protection Requirements

6. Section 01 74 00 – Cleaning and Waste Management

7. Section 01 79 00 – Instruction of Owner's Personnel

8. Section 02 41 00 – Site Demolition

## 1.02 REFERENCES

A. Definitions

1. "Manufacturer's installation instructions" are manufacturer's written instructions; drawings; illustrative, wiring, and schematic diagrams; diagrams identifying external connections; and other such information pertaining to installation of equipment and materials. Installation instructions are printed instructions, including those attached to the equipment and materials, all inclusive.

2. “Salvage” items are equipment and materials shown in the Contract Documents for selective removal by the Contractor to furnish to the Owner. Contractor shall be responsible for removal, handling, and depositing of equipment and material to location designated by Owner.

B. Reference Standards

1. 29 CFR 1910, OSHA

2. ANSI A10 – Construction & Demolition Standards

## 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Review installation procedures under other Sections and coordinate work that must be performed with or before the work specified in this Section.

2. Notify other contractors in advance of work for connections to existing facilities to prevent delay of the Work.

3. Remove and dispose of equipment and materials indicated for demolition on the Contract Documents, unless indicated as salvage items for the Owner. Contractor shall obtain ownership of removed equipment and materials following Engineer and Owner approval. Dispose of equipment and materials in accordance with the Contract Documents

B. Sequencing

1. Contractor shall remove and demolish equipment and materials in sequence specified in Section 01 14 00 – Coordination with Owner’s Operations and following approval by Engineer and Owner.

2. Contractor shall replace equipment and materials removed without proper authorization from Engineer that are necessary for the operation of the existing facilities. Reinstallation of equipment and materials shall be to the satisfaction of the Engineer and at no cost to the Owner

C. Title to Equipment and Materials

1. Equipment and materials indicated for demolition and removal in the Contract Documents and not designated as Owner’s salvaged items shall become the Contractor’s property following removal from the Site. Contractor shall be responsible for legally disposing of the equipment and material.

2. Contractor shall have no right or title to any of the equipment, materials, or other items to be removed until the elements have been removed from the Site.

3. Contractor shall not sell or assign or attempt to sell or assign any interest in the equipment, materials, or other items until removal from Site.

4. Contractor shall have no claim against the Owner because of the absence of equipment, fixtures, and materials.

D. Salvage Equipment and Materials

1. Contract Documents indicate equipment and materials that will be retained by Owner. Owner has the right to request any demolished equipment and materials be retained at their discretion.

2. Contractor shall move salvaged equipment and materials to storage areas located at the Site as instructed by Owner.

3. Architectural equipment and materials may be salvaged for incorporation into the Work when approved by Engineer.

E. Use of Explosives: Contractor shall not use explosives or blasting equipment and material in the Work in accordance with the Contract Documents.

## 1.04 SUBMITTALS

A. Action/Informational Submittals

1. Construction electronic documentation as specified in this Section

2. Demolition Plan: Submit detailed description of methods, equipment, and sequence for demolition work, including means of ensuring stability of structures during demolition activities.

3. 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 name and number

2) Description of affected work of Contractor and work of others (if any)

3) Necessity for cutting

4) Effect on work of Owner, other contractors (if any), and structural or weatherproof integrity of Project

5) Description of proposed work including scope of cutting and patching, trades who will be executing the work, products proposed to be used, extent of refinishing, schedule of operations, and alternatives to cutting and patching, if any

6) Designation of entity responsible for cost of cutting and patching when applicable

7) Written permission of other contractors (if any) whose work will be impacted

4. 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 substitution request in accordance with the substitution request requirements of the Contract Documents and Section 01 61 00 – Product Requirements and Options

5. Product Data: Submit manufacturer's product data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces and means of protecting exposed reinforcement or other metal embedments.

6. Informational Submittal: 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.

7. Comply with submittal requirements of individual Specification Sections for patching materials.

## 1.05 SITE CONDITIONS

A. Owner does not assume responsibility for the actual conditions of structures and equipment to be demolished and removed.

B. Existing Site conditions shall be maintained to the greatest extent possible by the Owner to the time of Notice to Proceed.

C. Contractor shall perform investigations, explorations, and probes as necessary at the Site prior to initiating demolition work to ascertain any required protective measures before proceeding with demolition and removal. Contractor shall give particular attention to shoring and bracing requirements to prevent damage to the Work and existing structures.

D. Contractor shall verify measurements, dimensions and other conditions of each existing structure, system, equipment, and material indicated in the Contract Documents for new work prior to ordering equipment and materials.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. General

1. Provide materials and products in accordance with the individual Specification Sections and the Contract Documents.

2. Provide materials and products that visually match existing adjacent surfaces to fullest extent possible for exposed surfaces.

3. If not indicated in the Contract Documents, provide materials and products that are identical to existing materials and products affected by the Work.

4. If identical materials and products are unavailable, provide materials and products that will equal or exceed performance requirements of existing materials and products.

B. Protective Coating Applied to Core-Drilled Surfaces and Cut Concrete Surfaces

1. All concrete surfaces exposed due to cutting or core drilling shall be coated with an epoxy resin coating: Sikagard 62 by Sika Corporation, Durakote 240 by Tamms Industries, or approved equal.

2. Reinforcement or other metal embedment exposed by concrete cutting or core drilling shall be burned back a minimum of 1/2 inch below surface, and resulting void shall be filled with an epoxy resin binder.

## PART 3 – EXECUTION

### 3.01 CONSTRUCTION ELECTRONIC DOCUMENTATION

A. Pre-Construction Documentation

1. Contractor shall take photographic and video documentation of the Site where Work is being performed. Engineer and Owner reserve the right to be present during documentation.

    a. Areas of the Site where the Work is being performed also include exterior/outdoor areas where excavation will occur for the installation of buried conduit and/or piping.

2. Contractor shall provide both photographic and video documentation at grade-level and aerial of the Site prior to commencing Work.

3. Contractor shall submit pre-construction documentation to Engineer and Owner for review. Contractor, Engineer, and Owner shall visit Site to field verify electronic documentation prior to commencing the Work. Site visit verification shall establish existing conditions prior to commencing the Work.

B. Construction Progress Documentation

1. Contractor shall document Work progress at locations and construction as directed by Engineer, at a minimum.

2. Contractor shall provide electronic documentation prior to and following any shutdown, switchover, demolition, decommissioning, cutting, patching, repair, etc. Engineer and Owner reserve the right to be present during documentation.

3. Contractor shall document following exposure of buried utilities, piping, valves, appurtenances, and other underground elements.

4. Engineer reserves the right to provide construction progress documentation to confirm Contractor’s electronic documentation.

C. Post-Construction Documentation

1. Contractor shall take photographic and video documentation of the Site where Work has been completed and prior to Substantial Completion or partial utilization

by Owner. Engineer and Owner reserve the right to be present during documentation.

2. Contractor shall provide both photographic and video documentation at grade-level and aerial of the Site following completion of the Work.

D. Submittal Requirements

1. Documentation shall be time stamped for verification, including date and time.

    a. If a single video file is transmitted instead of multiple video files, the video file shall contain selectable timestamps describing and corresponding with each general location, building/ structure, etc. that is the subject of the footage.

2. Documentation shall be organized in a logical manner, such as by structure, building, physical site location, etc. for ease of comparison.

    a. All photograph and video files that are electronically transmitted shall have filenames that briefly and succinctly describe the general location, building/ structure, etc. that is the subject of the documentation.

3. Photographic and video documentation shall be high-resolution electronic versions.

    a. Device(s) used for filming of photographic and/or video documentation shall have a maximum optical zoom of 3X or greater; the use of digital zoom during filming of photographic and video documentation is not acceptable whatsoever.

4. Filming photographic or video documentation while the photographer/videographer is positioned inside a vehicle, whether moving or stationary, is not acceptable.

5. Video documentation of each area, building/structure, etc. shall begin with an overall, zoomed-out view of the entire general area, building/structure, etc. The videographer shall then focus on each individual feature, component, etc. of the area, building/structure, etc. for a minimum of 3 seconds before steadily and slowly moving the camera to focus on the next individual feature, component, etc.

6. Documentation shall be submitted to Engineer for review and approval prior to commencing Work and at completion of the Work.

## 3.02 DEMOLITION

A. General

1. Demolition Work shall comply with the applicable provisions and recommendation of ANSI A10, all governing codes, and as specified in this Section.

2. Contractor shall furnish competent and experienced personnel for the various type of demolition and removal work. Demolition and removal work shall be performed with regard to the safety of Owner's employees, individuals at the Site, and the public.

3. Contractor shall confirm absence of embedded utilities prior to cutting, coring, or demolishing existing concrete and facilities. Verification shall be performed by portable x-ray, ground penetrating radar, or other non-invasive methods.

    a. Contractor shall notify Engineer and Owner if embedded utilities are located during the investigation. Contractor shall clearly mark and document location of embedded utilities prior to performing the associated cutting, coring, or demolition work.

    b. Contractor shall be responsible for repair and damages caused by exploration, investigation, and performance of the cutting, coring, or demolition work at no additional cost to Owner.

4. Contractor shall remove temporary work, such as enclosures, signs, guards, etc. when such temporary work is no longer required or when directed at the completion of the Work.

5. Contractor shall perform patching and restoration work in accordance with individual Specification Sections and details shown on the Drawings.

6. Contractor shall be responsible for damage caused by demolition work to existing structures, equipment and materials indicated for reuse or to remain at no additional cost to Owner.

7. Contractor shall maintain a clean working environment during the demolition work in accordance with Section 01 74 00 – Cleaning and Waste Management.

8. Contractor shall proceed with the demolition work in a sequence designed to maintain the plant in operation in accordance with Section 01 14 00 – Coordination with Owner's Operations.

9. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris. Select fill or structural fill shall be used where specifically required in the Specifications or on the Drawings.

10. All debris resulting from the demolition and removal work shall be disposed of by the Contractor at a properly permitted facility as part of the work of this Contract. All regulations covering material handling and disposal shall be followed. Material designated by the Engineer to be salvaged shall be stored on the Site as directed. All other material shall be disposed of off-site by the Contractor at his expense. Burning of any debris resulting from the demolition will not be permitted at the site.

B. Protection during Demolition

1. Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, personnel engaged in demolition work, and adjacent construction.

2. Contractor shall provide and maintain weather protection at exterior openings to fully protect the interior premises against damage from the elements until such openings are closed.

3. Contractor shall provide and maintain temporary protection of the existing structures designated to remain where demolition and removal work is being performed, connections made, materials handled, or equipment moved. Temporary protection shall be provided in accordance with Section 01 71 33 – Protection of Work and Property.

4. Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster, and similar debris. Unaltered portions of the existing buildings affected by the operations in the Contract Documents shall be protected by dustproof partitions and other adequate means. Dust control shall be provided in accordance with Section 01 57 00 – Temporary Controls.

5. Contractor shall provide adequate fire protection in accordance with Section 01 51 00 – Temporary Utilities and authorities having jurisdiction.

6. Contractor shall perform the demolition work with minimum traffic interference. Contractor shall not close or obstruct walkways, passageways, or stairways. Contractor shall not store or place materials in passageways, stairs, or other means of egress.

7. Contractor shall minimize disturbances to exterior walls and roofs to small sections that are readily repaired and patched to maintain watertight conditions in existing structures and buildings.

C. Performance of Demolition

1. Equipment, Piping, Valves, and Appurtenances

a. Contractor shall drain equipment, piping, valves, and appurtenances prior to demolition work. Contractor shall be responsible for collection, transport, and disposal of drained contents at no additional cost to the Owner.

b. Contractor shall provide line stops, plugs, blind flanges, etc. for equipment, piping, valves, and appurtenances required to remain in service during the

Project. Contractor shall provide temporary or permanent supports in accordance with the Contract Documents.

c. Supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise noted in the Contract Documents.

d. Concrete bases, anchor bolts and other supports shall be removed to approximately 1 inch below the surrounding finished area and the recesses shall be filled with epoxy resin binder.

e. Wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas in accordance with the Contract Documents and as directed by the Engineer.

f. Wall sleeves, wall pipes, and wall castings shall be plugged or blanked off in accordance with the Contract Documents and as directed by the Engineer.

g. Openings in concrete shall be closed in accordance with the Contract Documents and as directed by the Engineer.

2. Electrical Components and Equipment

a. Contractor shall de-energize panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation (e.g., flow, level and/or other meters), wiring, and similar electrical equipment prior to removal.

b. Contractor shall relocate or isolate electrical equipment and materials that serve equipment, piping, valves, and appurtenances that are to remain in service during the Project. Relocation or isolation work shall be sequenced and scheduled in accordance with Section 01 14 00 – Coordination with Owner's Operations.

3. Reused and Relocated Equipment

a. Contractor shall receive approval from Engineer prior to removal and relocation of equipment and material. Equipment and materials removed by Contractor prior to Engineer's approval that is required for Owner's operation of the facility shall be reinstalled at no cost to the Owner.

b. Prior to removal and relocation work, equipment and materials indicated for reuse and relocation shall be operated by Owner with Contractor and Engineer present to witness existing functionality and operation.

c. Contractor shall provide personnel responsible for reinstallation of equipment and material for the removal work.

d. Contractor shall be responsible for providing storage and protection of equipment and materials in accordance with Section 01 66 00 – Product Storage and Protection Requirements until relocation and reinstallation work is performed.

e. Contractor shall provide replacement equipment and material that is damaged during the removal work at no cost to the Owner. Contractor shall be responsible for providing same type, model, electrical components, etc. of damaged equipment and material as approved by Engineer and Owner.

4. Structural Removal

a. Contractor shall furnish and install temporary shoring, struts, and bracing required for the demolition work to ensure stability during entire demolition process.

b. Contractor shall cut and remove structural material at the interface of demolition work and the existing structural element. Cutting and removal shall occur in small sections, including masonry units, to prevent instability of structural elements.

c. Contractor shall patch, repair, and refinish adjacent surfaces that remain following demolition work.

1) Adjacent surfaces shall be repaired and refinished to the condition prior to the demolition work and in accordance with the Contract Documents.

2) Adjacent surfaces shall be cleaned of dirt, grease, loose paint, etc. prior to refinishing.

d. Contractor shall limit cutting of existing roof areas designated to remain to the limits required for the proper installation of the associated work.

1) Cut and remove insulation, joists, flashing, membranes, shingles, metals, etc. in accordance with the Contract Documents and as directed by the Engineer for installation of the associated work.

2) Provide temporary weather tight protection as required until new roofing and flashings are installed.

5. Architectural repair and removal work not specifically shown on the Drawings may include, but not limited to, the following:

a. Brickwork: Re-pointing and removing and replacing broken, cracked, disintegrating and missing materials

b. Windows: Removing cracked or disintegrating sealant material, replacing missing or broken glass, re-caulking and sealing frames, and glazing sealants

c. Re-Finishing: Removing rust, sealing, or peeling paint from surfaces by scraping, sanding or wire brushing and priming and repainting surfaces

d. Roofing: Patching and repairing membrane or built-up roofing, metal flashing repair, correcting roof pitch to eliminate ponding, and cleaning and/or replacing roof drains

e. Masonry: Cutting and installing new expansion and control joints

f. Parapets: Removing and construction of new walls and copings, cleaning and patching of copings, and replacing copings where broken

g. Concrete Surfaces: Patching, cleaning, sealing and resurfacing floors, walls, lintels, sills, and trim; replacing lintels where broken; and patching or replacing broken, spalled, cracked and disintegrating concrete encased steel columns and piers

h. Openings: Cutting and modifying as required for the Work and provide new lintels, doors, and frames

i. Doors: Patching and refinishing doors and frames

j. Ceilings: Patching, refinishing, and replacing

k. Guards, Handrails, and Appurtenances: Cleaning and repainting steel materials and replacing steel material with new aluminum material

l. Demolished Exterior Openings: Removing window sash, frame, sill, stool and trim at exterior doors indicated for enclosure and sealing and providing brick and/or masonry block for closure and sealing

D. Maintenance during Demolition

1. Contractor shall maintain the buildings, structures, and public properties free from accumulations of waste, debris and rubbish generated by the demolition work.

2. Contractor shall provide cleaning and waste management of demolition equipment and materials in accordance with Section 01 74 00 – Cleaning and Waste Management.

## 3.03 CUTTING AND CORING

A. General

1. Contractor shall notify Engineer in writing and receive Engineer's approval prior to cutting load bearing walls (concrete or masonry) and structural concrete floors.

2. Perform cutting and coring to limit extent of patching required.

3. Structural Elements: Do not cut or core structural elements in manner that would change structural element's load-carrying capacity or load deflection ratio.

4. Operating Elements: Do not cut or core operating elements in manner that would reduce capacity to perform as intended. Do not cut or core operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.

5. Replace, patch, and repair materials and surfaces cut or damaged during cutting and coring work. Contractor shall use methods that do not void required or existing warranties.

6. Provide temporary or permanent bypass provisions prior to cutting existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated in accordance with the Contract Documents.

7. Inspection: Examine and prepare surfaces prior to commencing associated work. Contractor shall report unsatisfactory or questionable conditions to Engineer in writing. Contractor shall not proceed with the associated work until unsatisfactory conditions are corrected.

8. Preparation

   a. Provide temporary support required to maintain structural integrity, protect adjacent work from damage, and support the element(s) to be cut or cored.

   b. Protection of Existing Construction during Cutting and Coring

      1) Protect existing structures, equipment, and materials during cutting and coring to prevent damage.

      2) Provide protection from adverse weather conditions that will be exposed during cutting and coring work.

      3) Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

9. Restoration

    a. Clean equipment, materials, piping systems, valves, conduit and appurtenances that were damaged due to the Work prior to applying paint or other finishing materials.

    b. Restore damaged pipe coverings, including insulation, to original condition.

B. Cutting

1. General

    a. Cut existing structures and appurtenances that provide surfaces for installation or repair work. Cut existing construction using methods to minimize damage and disturbance to retained and adjoining construction elements.

    b. Cutting equipment used shall be hand or small power tools suitable for sawing or grinding. Avoid using hammering or chopping equipment for cutting work.

    c. Cut holes and slots as small as possible and to size required for incorporation of the associated work and in accordance with the Contract Documents.

    d. Cut or drill from exposed or finished side to concealed side to avoid marring finished surfaces.

    e. Provide adequate bracing of area to be cut prior to cutting.

    f. Provide equipment and material to remove cut spoils.

    g. Provide temporary protection for cut openings where and when associated work is not being performed.

2. Concrete and Masonry

    a. Cut through concrete and masonry using concrete wall saw with diamond saw blades.

    b. Provide control for slurry generated during sawing on both sides of element being cut.

    c. After cutting concrete and before installing new work on or through the opening, coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer’s instructions.

C. Coring

1. Core-drill holes through concrete and masonry walls, slabs, or arches in accordance with the Contract Documents, unless written authorization is furnished by Engineer.

2. Protection: Protect existing structures, equipment, materials, utilities, and adjacent areas from water and other damage by core-drilling work.

3. Coring

a. Perform coring with non-impact rotary tool using diamond core-drills.

b. Size holes for pipe, conduit, sleeves, equipment, or mechanical seals, as required, to be installed through the penetration and in accordance with the Contract Documents.

c. After core-drilling and before installing equipment and material through the penetration, coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer's instructions.

4. Cleaning: Vacuum or otherwise remove slurry and tailings from the work area following core-drilling.

## 3.04 PATCHING

A. General

1. Construction shall be patched by filling, repairing, refinishing, closing-up, and similar methods at completion of the Work.

2. Provide equipment and materials in accordance with the Contract Documents for patching work. Comply with manufacturer's installation instructions.

3. Provide airtight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces during patching work. Provide durable patching seams that minimize visual appearance.

4. Patched areas shall be tested to demonstrate integrity of installation as directed by the Engineer. Contractor shall provide testing equipment, material, and services for patch testing.

B. Restoration

1. Restore exposed finishes of patched areas to minimize evidence of patching and refinishing.

2. Contractor shall extend refinishing and restoration into adjoining areas to blend patched areas with existing adjacent areas.

    a. Refinish to nearest intersection for continuous surfaces.

    b. Refinish the entire assembly and system for equipment and materials.

    c. Repair and rehang existing ceilings to provide an even-plane surface of uniform appearance.

    d. Apply plaster and finishes to match adjacent interior walls and partition areas for openings sealed with brick and/or masonry block.

## 3.05 INSTALLATION

A. Install equipment and materials in accordance with the Contract Documents, approved shop drawings, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from Engineer before proceeding.

B. Preparation of surfaces shall be performed prior to installation of equipment and material.

1. New Floor Finishes: Repair and patch with concrete, asphalt latex type emulsion and underlayment as required for existing surfaces or new flooring surfaces.

2. Ceramic Tile Flooring or Bases Installed over Concrete Floors: Grind away cove, if present, for installation of associated new work.

C. Concrete surfaces shall achieve compression strength in accordance with the Contract Documents prior to installation of equipment and materials.

1. Anchor bolts and templates shall be provided by Contractor as specified in the individual Specification Sections.

2. Concrete foundations shall be treated with sealer to prevent oil from seeping into concrete as specified in the individual Specification Sections.

D. Maintain the work area in a broom-clean condition while installing materials and equipment.

E. Contractor shall be responsible for equipment for hoisting, lifting, moving, rigging, etc. for installation of equipment and materials.

1. Contractor shall be responsible for design of temporary installation system used for the installation work, unless otherwise indicated in the Contract Documents.

2. Contractor shall be responsible for damage to existing structures, equipment, and material caused prior, during, and following installation of the associated work with the Contractor-furnished temporary installation system at no cost to Owner. Repairs shall be in accordance with the Contract Documents, shall return to condition prior to installation work, and as directed by the Engineer.

3. Owner's hoists, monorails, bridge cranes, rigging, etc. shall not be used by the Contractor unless written authorization is provided by Owner.

F. Alteration or repair of new equipment and materials shall not be permitted without written authorization from Engineer.

G. Field welding or burning of new equipment and materials shall not be permitted unless indicated in the Contract Documents or written authorization from Engineer is provided.

H. Contractor shall install temporary shoring and bracing where necessary during installation work where required:

1. System shall be provided in accordance with the Contract Documents and code requirements.

2. Temporary system shall consist of adjustable sound timbers or rolled shapes easily removable following the associated installation work.

3. Contractor shall be responsible for damage to existing structures and new work during installation, utilization, and removal of the temporary system at new additional cost to the Owner.

I. Manufacturer's Installation Services: Provide competent, qualified manufacturer's representatives of equipment and material for services specified in the individual Specification Sections including, but not limited to:

1. Supervising installation

2. Checking the completed installation

3. Adjusting and testing of equipment and materials

4. Instructing Owner's operations and maintenance in accordance with Section 01 79 00 – Instruction of Owner's Personnel.

**END OF SECTION**

## SECTION 01 73 23

## ANCHORAGE AND BRACING OF NONSTRUCTURAL COMPONENTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to design and provide anchorage and bracing for all nonstructural components in accordance with the Contract Documents and governing Building Code requirements, including the seismic design requirements of Chapter 13 in ASCE 7.

B. This Section covers requirements for only the anchorage and bracing of nonstructural components. Design requirements for nonstructural components (other than their anchorage and bracing) are covered in the Section for that component.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 33 – Special Inspections

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Further requirements for anchorage and bracing are included in other Sections of the Specifications. See Section for the specific nonstructural component in question.

### 1.03 DEFINITIONS

A. Nonstructural Components: All architectural, mechanical, electrical, or plumbing elements or systems and their supports or attachments provided under this Contract which are permanently attached to new or existing structures.

1. Architectural nonstructural components include, but are not limited to, interior nonstructural walls and partitions, exterior wall panels and glazing elements, glass curtain walls, skylights, cabinets, suspended ceilings, fascia, and cladding.

2. Mechanical nonstructural components include, but are not limited to, HVAC units, fans, water and wastewater treatment process equipment, instrumentation cabinets, piping and ductwork.

3. Electrical nonstructural components include, but are not limited to, conduit systems, cable tray systems, boxes, transformers, panelboards, switchboards, switchgear, busway, individual motor controllers, motor control centers, variable frequency drives, automatic transfer switches, and lighting systems.

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4. Plumbing nonstructural components include, but are not limited to, sprinkler systems and associated piping, and sump pumps.

B. Attachment: Elements including anchor bolts, welded connections, and mechanical fasteners which secure nonstructural components or supports to the structure.

C. Essential Components: Nonstructural components considered necessary to public safety for which the component importance factor $I_p$ is required by Chapter 13 in ASCE 7 to be taken as 1.5, including:

1. Life safety systems which must function following an earthquake including, but not limited to, sprinklers for fire protection, emergency lighting, egress corridors and stairways, and smoke purge systems.

2. Components which contain, convey or support toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the governing Building Code.

3. Components which are within or attached to an Occupancy or Risk Category IV structure as defined in ASCE 7 Chapter 1 and are needed for continued operation of the facility or where failure could impair the continued operation of the facility.

4. Components which contain, convey, or support hazardous substances and are attached to a structure or portion thereof classified by the governing Building Code as a hazardous occupancy.

5. Process systems and elements designated below:

a. Thermal Fluid Heater Piping.

D. Nonbuilding Structures: All self-supporting structures which are supported by an independent foundation or by other structures which include, but are not limited to, storage tanks, silos, exhaust stacks, storage racks, and towers.

E. Delegated Design: Design of a structure or structural element(s) which has been deferred by the Contract Documents to be performed during the Project construction stage by a registered design professional retained by the Contractor and with the design submitted as a shop drawing to the Engineer.

## 1.04 REQUIREMENTS

A. Anchorage and bracing of nonstructural components shall be designed and installed to resist the controlling load combination of gravity loads, operational forces (including static and dynamic), wind forces, seismic forces and any other applicable forces required in accordance with the governing Building Code.

B. Anchorage and bracing of nonstructural components shall comply with seismic design requirements of ASCE 7 Chapter 13 unless the nonstructural component meets the

criteria to be exempt. The following nonstructural components are exempt from requirements specific to seismic anchorage and bracing: (See Article 1.07, Paragraph F, Item 3 herein for Seismic Design Category)

1. Storage cabinets no more than 6 feet tall, furniture, and movable equipment, regardless of Seismic Design Category

2. All architectural, mechanical, electrical, and plumbing nonstructural components in Seismic Design Category A

3. All mechanical, electrical, and plumbing nonstructural components in Seismic Design Category B

4. Architectural nonstructural components in Seismic Design Category B, other than parapets, provided that $I_p = 1.0$

5. Mechanical, electrical, and plumbing nonstructural components in Seismic Design Category C provided that either:

    a. $I_p = 1.0$, and the component is positively attached to the structure; or

    b. Component weighs 20 lbs. or less or 5 lb/ft or less for distribution systems.

6. Mechanical, electrical, and plumbing nonstructural components in Seismic Design Category D, E or F that are positively attached to the structure, provided that either:

    a. $I_p = 1.0$, component weighs 400 lbs or less and its center of mass is 4 feet or less above a floor level, and flexible connections are provided between the components and associated ductwork, piping and conduit; or

    b. Component weighs 20 lbs. or less or 5 lb/ft or less for distribution systems.

7. Other exemptions as allowed by the Specifications, Codes and Standards referenced herein.

## 1.05 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. The Building Code shall be the version in effect at the time of Bid within the jurisdiction where the Work is located. All other referenced specifications, codes, and standards refer to the version as referenced by the Building Code. If no version is referenced by the Building Code, then the most current issue available at the time of Bid shall be used.

1. Georgia State Minimum Standard Building Code

2. ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures

3. NFPA 13 – Standard for Installation of Sprinkler Systems

4. FEMA 412 – Installing Seismic Restraints for Mechanical Equipment

5. FEMA 413 – Installing Seismic Restraints for Electrical Equipment

6. FEMA 414 – Installing Seismic Restraints for Duct and Pipe

7. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems

8. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

9. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete

10. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete

## 1.06 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Anchorage and bracing submittals for all architectural, mechanical, electrical, and plumbing nonstructural components, elements, and systems that do not have a design for anchorage and bracing provided within the Contract Documents, including the following:

   a. Component manufacturer's cut sheets and fabrication details for equipment bases and foundations including dimensions, structural member sizes, support point locations and equipment operational loads. Equipment anchorage details shall clearly indicate anchor size, pattern, embedment, and edge distance requirements to satisfy operational, wind, seismic and other forces required by the governing Building Code. Details shall also indicate grout, bearing pads, isolators, etc. required for complete installation.

   b. Design calculations, signed and sealed by a Professional Engineer registered in the state of Georgia. Design shall include all loads and load combinations required by the governing Building Code. Separate calculation submittals for vertical and lateral load support systems shall not be allowed.

   c. Detailed shop drawings signed and sealed by a Professional Engineer registered in the state of Georgia showing specific details of the support design including material, installation, attachments, connection hardware, etc. and the layout and location of all hangers and supports (resisting both gravity and lateral loads), including bracing orientation and direction of force(s) to be resisted.

   d. Seismic loads and requirements are not required to be included in design for anchorage and bracing of components which are exempt in accordance with Article 1.04, Paragraph B herein.

e. For components required to be certified as seismically qualified in accordance with Article 1.06, Paragraph A Item 1, Sub-Item f herein, submit installation guidelines provided by the equipment manufacturer for proper seismic mounting of the equipment.

f. Seismic qualification testing shall be based on ASCE 7 and on a nationally recognized testing standard procedure such as ICC-ES AC 156.

## 1.07 DESIGN REQUIREMENTS

A. Mechanical fasteners used to secure nonstructural components shall meet the requirements of Section 05 05 23 – Metal Fastening. Post-installed concrete anchors shall be prequalified for use in seismic applications.

B. No reaction loads (either vertical or lateral) from nonstructural component anchorage and bracing shall be allowed on any element where design has been delegated unless the additional loads on the element have been coordinated with the delegated designer and the submittal is accompanied by a sealed letter from the delegated designer indicating the element has been designed to support the reaction loads.

C. Reaction loads from nonstructural component anchorage and bracing shall be transferred directly to the primary structural members (girders, beams, etc.), with no components supported from secondary members (purlins, bracing, etc.) unless otherwise approved.

D. No holes shall be drilled into any structural steel for attachment of component supports without prior approval of the Engineer.

E. Attachments of nonstructural component anchorage and bracing that cause overstressing of any structural element shall not be permitted.

F. Seismic Requirements

1. Seismic anchorage and bracing for nonstructural components shall be subject to the current local Building Code in conjunction with the seismic provisions of the International Building Code Section 1613 and referenced ASCE 7 Chapter 13.

2. Where the weight of a nonstructural component is greater than or equal to 25 percent of the effective seismic weight (as defined by ASCE 7) of the structure it is attached to, the component shall be classified as a nonbuilding structure for purposes of seismic design. Seismic design for nonbuilding structures shall comply with Building Code requirements in conjunction with the provisions of ASCE 7 Chapter 15.

3. Nonstructural components shall be assigned to the same Seismic Design Category as the structure they occupy or to which they are attached. Design of seismic support system and anchorage shall incorporate the site-specific seismic

criteria given on the Drawings. Criteria shall include site-specific spectral response coefficients, Site Class, Seismic Design Category, and Risk Category.

4. Component Importance Factor Ip shall be 1.5 for all essential nonstructural components noted in item 1.03.E above. All other nonstructural components shall utilize $I_p$ = 1.0 unless noted otherwise.

5. Components shall be anchored and braced for earthquake forces both in the vertical and each orthogonal direction. Seismic anchorage and bracing shall limit deflections of components per ASCE 7, and the displacements shall not impede component functionally and containment.

6. Anchorage design shall account for disparate seismic response behavior of supporting structures. Seismic supports or bracing shall not cross structural expansion joints. Nonstructural components shall not be attached to multiple structural elements which may respond differently during a seismic event without provisions to accommodate independent movement. Flexible expansion loops or offsets, flexible joints, bellows type pipe expansion joints, couplings, etc. shall be provided at structure expansion joints to allow for independent structure movement and thermal movement of piping, ductwork, and conduit. Minimum movement capability in the vertical and each orthogonal direction shall equal the width of the joint.

7. Provide flexible connections, piping, conduit, etc. at foundation levels where below grade utilities enter the structure.

8. Design of support system for components with multiple attachments shall consider the stiffness and ductility of the supporting members. Equipment designed as free-standing shall only be attached at its base. Use of non-free-standing equipment requiring both vertical and lateral attachment is contingent upon loads applied to the structure and requires approval by the Engineer.

9. The seismic anchorage and bracing design shall be based on actual equipment data (dimensions, weight, center of gravity, etc.) obtained from the specifications or the approved equipment manufacturer. The equipment manufacturer shall verify the attachment points on the equipment can safely withstand the combination of seismic, self-weight and other loads imposed.

G. Powder actuated fasteners in steel or concrete shall not be used for sustained tension loads in Seismic Design Categories D, E or F unless approved for seismic loading or specifically exempted by ASCE 7. Powder-actuated fasteners in masonry shall not be used unless approved for seismic loading regardless of Seismic Design Category.

H. Friction clips shall not be used in Seismic Design Categories D, E or F for supporting sustained tension loads in combination with resisting seismic forces. C-type and large flange clamps may be used for hanger attachments provided restraining straps meeting

NFPA 13 requirements are utilized and loosening of threaded connections is prevented by lock nuts, burred threads, etc.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

A. Anchorage and bracing of nonstructural components shall be constructed of appropriate materials and connecting hardware to provide a continuous load path between the component and supporting structure of sufficient strength and stiffness to resist the calculated design seismic forces and displacements.

B. Component anchorage, bracing and connection materials shall be compatible with and in general match the component and component gravity support materials. Contact between dissimilar metals shall be prevented.

## PART 3 – EXECUTION

### 3.01 INSTALLATION OF ANCHORAGE AND BRACING

A. No anchorage and bracing of nonstructural components shall be installed prior to review and acceptance by the Engineer and permitting agency.

B. Equipment shall be installed per the manufacturer's recommendations. Fasteners shall meet manufacturer's requirements.

C. Following installation, all anchorage and bracing and seismically qualified equipment shall be inspected. See Section 01 45 33 – Special Inspections for requirements.

**END OF SECTION**

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# SECTION 01 74 00
# CLEANING AND WASTE MANAGEMENT

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Administrative and Procedural Requirements for Progress and Closeout Cleaning at the Site

1. Contractor shall execute cleaning during the Project, at completion of the Work, and as required by the General Conditions and this Section.

2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

B. Administrative and Procedural Requirements for Disposing of Non-Hazardous Excavation and Construction Waste

1. Contractor shall comply with the requirements and procedures for construction waste management and disposal, including developing and implementing a plan for construction waste management and disposal.

2. Extent of required construction waste management and disposal includes within the Project limits, as shown or indicated.

### 1.02 REFERENCES

A. Definitions

1. “Waste Management Coordinator” is the person responsible for implementing, monitoring, and reporting the status of the Waste Management Plan. Although available for other assignments, the Waste Management Coordinator shall be present at the Site full time for the duration of the Work.

2. “Construction waste” is building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

3. “Demolition waste” is building and site improvement materials resulting from demolition or selective demolition operations.

4. “Disposal” is removal to an off-Site location of demolition and construction waste and subsequent sale, recycling, reuse, or disposal in a landfill or incinerator conforming to Laws and Regulations and acceptable to authorities having jurisdiction.

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B. Reference Standards: NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations

## 1.03 ADMINISTRATIVE REQUIREMENTS

A. Waste Management Plan

1. General: Develop preliminary plan consisting of waste identification. Indicate quantities by weight or volume. Use the same units of measure throughout waste management plan.

2. Waste Identification: Indicate anticipated types and quantities of excavation waste generated by the Work.

3. Waste Reduction Work Plan: List each type of waste and whether waste will be disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

a. Salvaged Materials for Reuse: For materials that will be salvaged and reused in the Work, describe methods for preparing salvaged materials before incorporating them into the Work.

b. Disposed Materials: Provide information on how and where materials will be disposed. Include name, address, and telephone number of each landfill and incinerator facility that will be used.

c. Handling and Transportation Procedures: Provide information on the method(s) that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location at the Site where materials separation will be located.

B. Failure of Contractor to Maintain Clean Site and Waste Management Plan

1. Owner will provide written notification to Contractor for failure to maintain a clean Site and waste management plan.

2. Written notification shall provide 5 days for Contractor to remedy Site cleaning and waste management to the Engineer’s and Owner’s satisfaction.

3. Following the 5-day remedy period, Owner will, without prejudice to any other rights, provide services to clean Site to the satisfaction of Owner and Engineer. Contractor shall be responsible for reimbursement of Owner’s costs and expenses for the cleaning work.

## 1.04 SUBMITTALS

A. Action/Informational Submittals

1. Preliminary Waste Management Plan: Prepare in accordance with this Section and submit within 14 days of the Notice to Proceed and prior to removing waste from the Site.

2. Final Waste Management Plan: Submit within 14 days of receiving Engineer's comments on the preliminary waste management plan.

B. Closeout Submittals

1. Landfill and Incinerator Disposal Records: Provide copy of receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Submit manifests, weight tickets, receipts, and invoices.

## 1.05 DELIVERY, STORAGE AND HANDLING

A. Replace loaded containers with empty containers as demand requires.

B. Deposit recyclable materials in containers free from debris.

C. Transport and deposit waste in containers to minimize dust. Close container covers immediately after materials are deposited.

# PART 2 – PRODUCTS (NOT USED)

# PART 3 – EXECUTION

## 3.01 PROGRESS CLEANING

A. General: Clean the Site, work areas, and other areas occupied by Contractor at least weekly. Dispose of materials in accordance with the General Conditions and the following:

1. Comply with NFPA 241 for removing combustible waste materials and debris.

2. Do not hold non-combustible materials at the Site more than 3 days if the temperature is expected to rise above 80 degrees Fahrenheit. When temperature is less than 80 degrees Fahrenheit, dispose of non-combustible materials within 7 days of their generation.

3. Provide suitable containers for storage of waste materials and debris.

4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Work Areas

1. Clean areas where the Work is in progress to level of cleanliness necessary for proper execution of the Work.

2. Remove liquid spills promptly and immediately report spills to Owner, Engineer, and authorities having jurisdiction.

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.

C. Installed Work: 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.

D. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

E. Cutting and Patching

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

2. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

F. 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.

G. Clean completed construction as frequently as necessary throughout the Contract Times.

## 3.02 EXCAVATION WORK NEAR PUBLIC OR PRIVATE PROPERTY

A. Contractor shall provide cleaning and either temporary or permanent restoration where a portion of the Work is located in or near streets, right of ways, easements, or private property.

B. Contractor shall backfill, compact, grade, and restore excavation or disturbed area to functional condition to permit pedestrian or vehicular traffic and original use of the area as the Work progresses.

C. Temporary storage of excavation spoils, including earth, stones, boulders, and debris, shall be removed from the Site or area of disturbance.

## 3.03 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. 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.

6. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign substances.

7. Leave the Site clean and in neat, orderly condition, satisfactory to Owner and Engineer.

## 3.04 WASTE MANAGEMENT IMPLEMENTATION

A. General: Implement the waste management plan approved by Engineer. Provide handling, containers, storage, signage, transportation, and other items required to implement the waste management plan during the Project.

B. Training: Train all installers, Subcontractors, and Suppliers as required on proper waste management procedures required for the Work.

1. Distribute the waste management plan as required within 3 days of Engineer's approval.

2. Distribute the waste management plan to Contractor's personnel, Subcontractors, and Suppliers prior to these entities starting the Work. Review with installers, Subcontractors, and Suppliers the waste management plan's procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent facilities. Designate and label specific areas of the Site necessary for separating materials to be disposed.

## 3.05 WASTE DISPOSAL

A. General: Except for items or materials to be 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.

3. Properly dispose of waste materials, surplus materials, debris, and rubbish off the Site.

4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.

5. Do not discharge wastes into surface waters or drainage routes.

B. Burying: Do not bury rubbish and waste materials at the Site.

C. Burning: Do not burn waste materials at the Site.

D. Disposal: Transport waste materials to proper location at site other than Owner's property for disposal in accordance with Laws and Regulations. Contractor shall be solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste.

## 3.06 SNOW AND ICE REMOVAL

A. The Contractor shall remove snow and ice from the following areas:

1. The sidewalks and parking areas associated with the Engineer’s field office

2. All construction access roads

    a. Any walkways which cannot be accessed by the Owner's snow removal equipment due to construction activities.

    b. Any additional areas designated by the Engineer.

3. Snow and ice removal shall be completed prior to starting daily Work activities.

4. When directed by the Engineer, the Contractor shall begin snow and/or ice removal immediately.

5. Contractor shall haul the removed snow and ice for disposal as per the applicable local rules.

6. Spreading of Salt and Sand

    a. The Contractor shall furnish all labor, tools, equipment, and materials necessary to provide the following services specifically requested and authorized in writing by the Engineer:

        1) Spread calcium chloride over all areas of the Engineer’s parking lot and spread sand on the steps and platforms at the entrances to the Engineer’s field office.

        2) Salt and sand shall be spread prior to a snowstorm.

        3) Upon termination of a snowstorm, the Contractor shall remove all sand from the steps and platforms at the entrances to the Engineer’s field office.

    b. Disposal of sand shall be the responsibility of the Contractor.

**END OF SECTION**

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# SECTION 01 75 00
# CHECKOUT AND STARTUP PROCEDURES

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Checkout of products and equipment

2. Startup procedures of products and equipment

B. 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.

C. Provide all material, labor, tools, and equipment required to complete equipment checkout and startup.

D. Provide chemicals, lubricants, and other required operating fluids.

E. General activities include:

1. Cleaning as required under other provisions of the Contract Documents

2. Removing temporary protective coatings

3. 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

4. All adjustments required

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Definitions

1. "Displacement", as used herein, shall mean total peak-to-peak movement of vibrating equipment in mils; velocity or speed of the vibration cycle measured in distance per time; and velocity and acceleration of the vibration cycle. Displacement, velocity and acceleration shall be measured by instruments/equipment equal to IRD Mechanalysis, Bentley, Nevada.

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B. Coordination

1. Coordinate checkout and startup with other contractors performing work at the Site.

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 startup of equipment, but responsibility for proper operation shall be by Contractor.

4. Supplier shall be present during checkout, startup, and initial operation, except as otherwise specified.

5. 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 – Operation and Maintenance Data.

C. Contractor's Requirements Prior to Owner's Responsibility

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 shall be in accordance with this Section and the following requirements:

a. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

b. Provide training of operations and maintenance personnel in accordance with Section 01 79 00 – Instruction of Owner's Personnel.

c. Complete system field quality control testing in accordance with the Contract Documents including, but not limited to, the following:

1) Startup certification shall be performed and completed by the Supplier of the equipment and material prior to being placed into intended use by Owner as specified in the Contract Documents.

2) Equipment and material shall be operated for a minimum 30-day operational period to verify performance. In addition to specific requirements specified in the individual specification sections, process data that is recorded in the programmable logic controller (PLC) shall be submitted to the Engineer in tabular format showing hourly process performance data. A log of all alarms shall also be submitted, along

with notes describing corrective measures applied in response to alarm condition.

3) If equipment and material does not perform satisfactorily during the 30-day operational period, then the warranty period start shall be delayed until satisfactorily performance is verified.

a) Contractor shall repair or replace equipment and material that does not perform satisfactorily at no cost to Owner.

b) Contractor shall furnish all equipment and material, labor, and incidentals necessary to provide equipment and material to the performance level required by the Contract Documents.

d. Obtain from Engineer final Certificate of Substantial Completion for either entire Work or the portion being turned over to Owner (i.e., partial utilization).

## 1.03 SUBMITTALS

A. Startup Schedule: Detailed summary of schedule, duration, manpower requirements, and Contractor's means and methods for startup

B. Vibration testing results

C. Closeout Submittals: Manufacturer's certification of installation in accordance with this Section

D. Startup testing and operational demonstration performance data

# PART 2 – PRODUCTS (NOT USED)

# PART 3 – EXECUTION

## 3.01 PRELIMINARY REQUIREMENTS

A. Prior to the startup of the facilities, Contractor shall have prepared and tested all equipment, subsystems and systems in accordance with the requirements of the individual Specification Section(s) to check its ability for sustained operation, including inspections and adjustments by Manufacturer's representative.

B. Contractor shall develop and submit schedule in accordance with this Section.

C. After the facilities are sufficiently complete to permit startup, Contractor shall furnish competent personnel to start up the facilities. Contractor shall be responsible for startup of all facilities constructed under this Contract. During the initial startup period, the

Contractor shall check and provide for mechanical operation in accordance with the Contract Documents.

## 3.02 FIELD QUALITY CONTROL

A. Manufacturers' Field Services

1. When specified, furnish services of factory-trained representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, startup, and testing of materials and equipment.

2. Certification

a. When services by manufacturer are required at the Site, within 14 days after first test operation of equipment, submit to Engineer a letter from manufacturer on manufacturer's letterhead stating that materials and equipment are installed in accordance with manufacturer's requirements and installation instructions and in accordance with the Contract Documents.

b. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3. Manufacturer shall bring any discrepancies to the immediate attention of the Contractor for correction. Contractor shall promptly correct any discrepancies noted by the Manufacturer. Manufacturer shall coordinate correction of discrepancies with the Contractor. Discrepancies and their correction shall be noted in inspection records and in all required reports. Any corrections that result in changes to the work as shown on the Contract Documents shall be approved by the Engineer prior to their execution.

## 3.03 VIBRATION TESTING

A. Stationary rotating equipment, products and materials shall have vibration testing performed at the Site with a rated horsepower exceeding 40 horsepower unless otherwise noted in an individual equipment Specification Section.

B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert and shall be provided for and paid for by the Contractor. Each unit or pump system shall be separately tested without duplicate equipment running. All field testing shall be performed in the presence of the Engineer. The Engineer shall be furnished with seven certified copies of vibration test data for each test performed.

C. General Testing Requirements

1. Variable Speed Drives: Tests shall be conducted at the full range of speeds between maximum and minimum.

2. Two-Speed Drives: Tests shall be conducted at both speeds.

3. Constant-Speed Drives: Tests shall be conducted under various loading conditions as determined by the Engineer.

4. Frequency of vibration, in frequency (i.e., Hz, cycles per second) and cycles per minute (cpm) shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing and the motor, unless other additional locations are deemed necessary by the Engineer and/or specified by the vibration analyst and/or published industry standards.

5. Vibration shall be checked in the radial and axial directions. Vibration shall be limited to that specified in the latest version of the following published standards: ISO and Hydraulic Institute (HI).

    a. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec and radial vibration shall not exceed 0.2 in/sec. For pumps, radial vibration shall not exceed that permitted by the HI Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.

6. Noise or vibration in any rotating equipment which the Engineer judges to be excessive or damaging shall be cause for rejection.

D. Test Results

1. Contractor shall correct deficiencies within 30 days when vibration field test results exceed source quality control test results, Manufacturer's recommendations, or the limits specified in the Contract Documents.

2. After corrections have been completed, the vibration testing shall be re-run at the Contractor's expense and the results re-submitted to the Engineer for review.

## 3.04 SYSTEM STARTUP

A. Equipment and materials shall be provided in conformance with the manufacturer's installation instructions and in accordance with the Contract Documents.

B. Provide startup services as specified in the individual Specification Sections.

C. Contractor shall furnish consumables required for startup including, but not limited to, electricity, water, chemicals and lubricants. Contractor shall provide a plan for disposal of water used for testing unless otherwise specified in the Contract Documents.

D. General System Requirements

1. Startup of the plant, individual facility, or portion thereof by Contractor shall include all mechanical systems including, but not limited to, pumps, compressors, and like equipment and the ventilating, air conditioning (and/or heating), plumbing, and electrical systems. Startup of either the heating or air conditioning systems shall be dependent upon the time of year that the plant startup is initiated. Contractor shall be required to return at the beginning of the next heating or air conditioning season (whichever is applicable) to start the appropriate system.

2. Cleaning as required under provisions of the Contract Documents

3. Removal of temporary protective coatings

4. Flushing and replacing greases and lubricants as required by Manufacturer

5. Lubrication

6. Verify the following:

    a. Shaft and coupling alignments and reset where needed.

    b. Set motor, pump and other equipment rotation, safety interlocks, and belt tensions.

    c. Leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping, conduits and ducts that may apply stress on equipment.

7. Valves

    a. Tighten packing glands to ensure no leakage but allow valve stems to operate without galling.

    b. Replace packing in valves to retain maximum adjustment after system is determined to be complete.

    c. Replace packing on valves that continue to leak.

    d. Remove and repair bonnets that leak.

    e. After cleaning, coat packing gland threads and valve stems with surface preparation of “Molycote” or “Fel-Pro”.

8. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

9. Tighten flanges and other pipe joints after system has been placed in operation.

10. Replace gaskets that show signs of leakage after tightening.

11. Inspect all joints for leakage.

    a. Promptly remake each joint that appears to be faulty; do not wait for rust or other corrosion to form.

    b. Clean threads on both parts and apply compound and remake joints.

12. After system has been placed in operation, clean valve seats and headers in fluid system to ensure freedom from foreign matter.

13. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

14. Repair damaged insulation.

**END OF SECTION**

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# SECTION 01 77 19
# CLOSEOUT REQUIREMENTS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Substantial Completion

2. Final inspection

3. Request for final payment

### 1.02 REFERENCES

A. Definitions

1. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as modified by Supplemental Conditions.

2. Procedures for requesting and documenting Final inspection are in the General Conditions, as modified by Supplemental Conditions.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Request for Final Payment

1. Procedure: Submit request for final payment in accordance with the Agreement and General Conditions, as modified by the Supplementary Conditions.

B. Request for final payment shall include:

1. Documents required for progress payments in Section 01 29 76 – Progress Payment Procedures

2. Documents required in the General Conditions, as modified by the Supplementary Conditions

3. Releases or Waivers of Lien Rights

a. Provide a final release or waiver by Contractor and each Subcontractor and Supplier that provided Contractor with labor, material, or equipment totaling $10,000 or more.

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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.

e. Manufacturer's Affidavit of Release of Liens: Furnish a separate, completed form from the manufacturer.

4. Submit consent of surety company to final payment.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 78 23
## OPERATION AND MAINTENANCE DATA

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes: Requirements for operation and maintenance data, manuals, and documentation

1. Submit operation and maintenance data in accordance with this Section and 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 groupings are listed in this Section. 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 equipment

3. For each operation and maintenance manual, submit the following:

a. Preliminary Submittal: Printed and bound hard copy of entire operation and maintenance manual and electronic copy, except for test data and service reports by Supplier

b. Final Submittal: Printed and bound hard copy of complete operation and maintenance manual and electronic copy, including test data and service reports by Supplier

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Quantity Required and Timing of Submittals

1. Preliminary Submittal

a. Hard Copies: One, exclusive of copies required by Contractor

b. Electronic Copies: One

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c. Submit to Engineer, whichever occurs first:

1) 60 days prior to starting training of operations and maintenance personnel

2) 30 days prior to field quality control testing at the Site

d. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before associated materials and equipment will be eligible for payment.

2. Preliminary Submittal will be reviewed by Engineer. One electronic copy will be returned to Contractor with required revisions noted.

3. Final Submittal: Provide 14 days prior to checkout and startup procedures specified in Section 01 75 00 – Checkout and Startup Procedures, unless submittal is specified as required prior to an interim Milestone.

a. Printed Copies: Two

b. Electronic Copies: One

c. Each final submittal, including printed copies, shall be provided to Owner in advance of conducting any training sessions as specified in Section 01 79 00 – Instruction of Owner's Personnel for the specific item of equipment, system, valve, gate, device, etc. that the submittal covers.

B. Format of Printed Copies

1. Binding and Cover

a. 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 1 inch wide and maximum of 3 inches wide. Binders for each copy of each volume shall be identical.

b. Provide the following information on cover and spine of each volume:

1) Title: "OPERATING AND MAINTENANCE INSTRUCTIONS"

2) Name or type of material or equipment covered in the manual

3) Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.

4) Name of Project and, if applicable, Contract name and number

5) Name of building or structure, as applicable

c. Provide the following information on spine of each volume:

2. Drawings

a. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.

b. 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.

3. Copy Quality and Document Clarity

a. 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.

b. 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.

4. Organization

a. Provide table of contents in each volume for each chapter or section.

b. 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.

C. Format of Electronic Copies

1. Each electronic copy shall include all information included in the corresponding printed copy.

2. Submit electronic copy via transferable method and format acceptable to Engineer.

3. File Format

a. Acceptable file formats include Portable Document Format (.pdf), Microsoft Word .docx, Autodesk .dwf, and AutoCAD .dwg

b. Files shall be completely electronically searchable.

c. Submit separate file for each separate document in the printed copy.

d. 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

4. Also submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", "dwf", or "dwg". Submit these files in a separate file directory as part of the electronic copy.

D. General Content Requirements

1. Prepare each operation 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. 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.

3. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

4. 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:

a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning, including pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns

b. Recommended schedule for each preventive maintenance task

c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied

d. Table of alternative lubricants

e. Troubleshooting instructions

f. List of required maintenance tools and equipment

5. 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:

   a. Manufacturer's name, address, telephone number, fax number, and Internet website address

   b. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and email addresses, when applicable

   c. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished

   d. For each part or piece include the following information:

      1) Parts cross-reference number, which 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.

      2) Part name or description

      3) Manufacturer's part number

      4) Quantity of each part used in each assembly

      5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

6. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).

7. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial 2 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.

8. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. 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.

9. 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.

10. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

11. Submit copy of warranty bond and service contract as applicable.

12. 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.

## 1.03 SUBMITTALS

A. Action/Informational Submittals: Submit preliminary schedule (listing) of operations and maintenance data for Engineer's review. Preliminary operations and maintenance data shall be grouped as major equipment and material systems and divided into sub-systems as required for clarity, subject to Engineer's approval.

B. Closeout Submittals

1. Operation and maintenance data: Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as approved by Engineer.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 SCHEDULE

| Specification Section Number | Title |
|---|---|
| 21 05 00 | Basic Fire Suppression Requirements |
| 21 13 13 | Wet Pipe Sprinklers |
| 21 13 24 | Fluorine-Free Foam Fire Suppression System |
| 22 05 19 | Meters and Gauges for Plumbing Piping |
| 22 11 19 | Domestic Water Piping Specialties |
| 22 34 00 | Fuel-Fired Domestic Water Heaters |
| 23 09 00 | HVAC Automatic Temperature Controls (Relay Logic) |
| 23 34 00 | HVAC Fans |
| 23 55 33 | Gas-Fired Unit Heaters |
| 23 74 01 | Commercial Air Handling Units for Indoor or Outdoor Applications |
| 23 74 05 | Positive Pressurization Units |
| 23 75 00 | Custom-Packaged HVAC Equipment |
| 23 81 26 | Split-System Air Conditioners |
| 23 82 16.14 | Electric-Resistance Air Coils |
| 26 22 00 | Low-Voltage Transformers |
| 26 24 16 | Panelboards |
| 26 24 19 | Low-Voltage Motor Control Centers |
| 26 28 16.16 | Enclosed Switches |
| 26 29 23 | Low-Voltage Variable Frequency Motor Controllers |
| 26 50 00 | Lighting |
| 28 46 20 | Fire Alarm Systems |
| 40 05 57 | Valve Operators and Electric Valve Actuators |
| 40 05 58 | Gate Operators and Electric Gate Actuators |
| 40 05 59.23 | Fabricated Stainless Steel Slide Gates |

| Specification Section Number | Title |
|---|---|
| 40 05 61 | Gate Valves (Including Knife Gate Valves) |
| 40 05 62 | Eccentric Plug Valves |
| 40 05 63 | Ball Valves |
| 40 05 64 | Butterfly Valves |
| 40 05 65.23 | Check Valves |
| 40 05 68.13 | PVC and CPVC Valves |
| 40 05 68.23 | Miscellaneous Valves |
| 40 62 63 | Operator Interface Terminals |
| 40 63 43 | Programmable Logic Controllers |
| 40 66 00 | Network and Communication Equipment |
| 40 67 00 | Control System Equipment Panels and Racks |
| 40 67 63 | Uninterruptible Power Systems |
| 40 72 76.26 | Level Switches (Floats) |
| 40 73 13 | Pressure and Differential Pressure Gauges |
| 40 76 21 | Single Point Gas Monitoring Systems |
| 40 78 00 | Panel Mounted Instruments |
| 40 78 56 | Isolators, Intrinsically Safe Barriers, and Surge Suppressors |
| 40 79 00 | Miscellaneous Instruments, Valves, and Fittings |
| 41 22 00 | Cranes and Hoists |
| 43 25 13.10 | Wet Pit Submersible Solids-Handling Pumps |
| 46 76 42 | Screw Conveyors |
| 46 76 70 | Indirect Thermal Sludge Drying System |

Note: The specified O&M data, manuals, and documentation for all items furnished by instrumentation and control system subcontractor under Division 40 – Process Interconnections shall be submitted together as two separate O&M Manuals (one for field instruments and one for programmable logic controllers with appurtenances) with dividers separating each individual item.

**END OF SECTION**

# SECTION 01 78 39
# PROJECT RECORD DOCUMENTS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Requirements for recording changes to record documents

2. Requirements for electronic files furnished by Engineer

B. Contractor shall maintain and submit to Engineer record documents in accordance with the Specifications, General Conditions, and Supplementary Conditions.

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Maintenance of Record Documents

1. The following record documents shall be maintained in the Contractor's field office:

   a. Drawings, Specifications, and Addenda

   b. Shop drawings, samples, and other Contractor submittals, including records of test results, approved or accepted as applicable, by Engineer.

   c. Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work

2. Update record documents every 2 weeks, minimum

3. Provide files and racks for proper storage and easy access to record documents.

4. Make record documents available for inspection upon request of Engineer or Owner.

5. 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.

6. Add all existing utilities encountered during construction to record documents if different from what is shown on Drawings.

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B. Submittal of Record Documents

1. Submit to Engineer the following record documents: Drawings.

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 certification, with original signature of official authorized to execute legal agreements on behalf of Contractor.

5. All record documents shall be provided as electronic copy in Portable Document Format (.pdf) and hard copy.

a. Electronic copy of final marked-up Drawings shall be full-size (22-inch x 34-inch) and scanned at a scale of 1:1 and a minimum resolution of 300 dpi.

C. Electronic Files Furnished by Engineer

1. Computer-aided drafting/design (CADD) files will be furnished by Engineer upon the following conditions:

a. 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.

b. 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.

c. 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.

d. Contractor shall submit record drawings to Engineer in same CADD format that files were furnished to Contractor.

## 1.03 SUBMITTALS

A. Closeout Submittals: Provide record documentation as specified in this Section.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 GENERAL REQUIREMENTS:

A. 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 2 inches high.

B. Keep record documents current. Make entries on record documents within 2 working days of receipt of information required to record the change.

C. Do not permanently conceal items of the Work until required information has been recorded.

D. 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.

E. Marking of Entries

1. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.

2. 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.

3. Date all entries on record documents.

4. Call attention to changes by drawing a “cloud” around the change(s) indicated.

5. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

### 3.02 RECORDING CHANGES TO DRAWINGS

A. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on the Drawings is not acceptable.

B. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.

C. Record actual construction including:

1. Depths of various elements of foundation relative to Project datum

2. Field changes of dimensions, arrangements, and details

3. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders

4. Changes in details on the Drawings, including submitting additional details prepared by Contractor when required to document changes

## 3.03 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 systems, 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 1 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 specific work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

## 3.04 REQUIREMENTS FOR 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 CADD software are to be included in record drawings, submit electronic files for such drawings in AutoCAD (latest version) as part of record drawing submittal.

## 3.05 RECORDING CHANGES TO SPECIFICATIONS AND ADDENDA

A. Mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided

2. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders

**END OF SECTION**

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## SECTION 01 78 43
## SPARE PARTS AND EXTRA MATERIAL

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall furnish spare parts data and extra materials for materials and equipment in accordance with the Contract Documents.

B. Spare Parts and Extra Materials

1. Provide spare parts, extra stock materials, maintenance supplies, and special tools required for maintenance (“spare parts and extra materials”) as specified in the individual Specification Sections.

a. Provide Supplier-recommended lubricating oil and grease in accordance with this Section and the Contract Documents.

2. As part of each operation and maintenance manual submitted, include list of Supplier-recommended spare parts and extra materials, including names, quantities, and part numbers, that Owner should maintain in stock for maintenance.

a. Include list of four standard lubricants, minimum, that shall be interchangeable for each type of lubricant required in the Contract Documents.

b. Include unit prices in current United States funds.

c. List source(s) of supply for each.

C. Packaging and Labeling

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 equipment, part number, part description, and part location in the equipment.

3. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.

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D. Finishes: Spare parts and extra material shall have painting, protective coatings, and finishes identical to original installed equipment and material. Where painting, protective coatings, or finishes are not specified, suitable provisions shall be furnished to protect from corrosion.

E. Special Tools: Contractor shall provide special tools necessary to operate, disassemble, service, repair, and adjust equipment and material in accordance with the manufacturer's operation and maintenance manual. Special tool requirements shall be the same as spare parts and extra material specified in this Section.

F. Storage Prior to Delivery to Owner: 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.

G. Delivery Time and Eligibility for Payment

1. Deliver to Owner spare parts and extra materials prior to date of Substantial Completion for equipment or system associated with the spare parts and extra materials. Do not deliver spare parts and extra materials before commencing startup for associated equipment or system.

2. Spare parts and extra materials are not eligible for payment (if applicable and approved by Engineer as part of review of Schedule of Values) until delivered to Owner and Contractor's receipt of Owner's countersignature on letter of transmittal.

H. 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, Engineer and Owner will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantities and part numbers.

3. Additional procedures for delivering spare parts and extra materials to Owner, if required, will be developed by Engineer and complied with by Contractor.

I. Transfer Documentation

1. Furnish on Contractor letterhead a letter of transmittal for spare parts and extra materials furnished under each Specification 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.

2. Furnish three original, identical, signed letters of transmittal for each Specification 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.

    a. Owner will retain one fully signed original.

    b. Contractor shall submit one fully signed original to Engineer.

    c. Contractor shall retain one fully signed original for Contractor's file.

3. Letter of transmittal shall include the following:

    a. Information required for letters of transmittal in Section 01 33 00 – Submittal Procedures.

    b. Transmittal shall list spare parts and extra materials furnished under each Specification Section. List each individual part or product and quantity furnished.

    c. Provide space for countersignature by Owner as follows: space for signature, space for printed name, and date.

J. Contractor shall be fully responsible for loss or damage to spare parts and extra materials until spare parts and extra materials are received by Owner.

## 1.02 SUBMITTALS

A. Action/Informational Submittals: For individual Specification Sections that require spare parts, extra material, or tools, Contractor shall submit inventory checklist for each individual Specification Section that includes the following information:

1. Specification Section number and title

2. Name of spare parts, extra material, or tools

3. Manufacturer, part number and description

4. Quantity specified and furnished

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01 79 00**

**INSTRUCTION OF OWNER'S PERSONNEL**

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Contractor shall furnish services of operation and maintenance training specialists to instruct Owner's personnel in recommended operation and maintenance procedures for materials and equipment furnished in accordance with the Contract Documents.

B. Contractor shall provide a combination of classroom and field training at the Site unless otherwise required elsewhere in the Contract Documents.

C. Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Definitions

1. Training: Manufacturer's verbal, visual, and written presentation of materials to Owner's personnel to ensure that any Owner personnel undergoing training understand the Manufacturer's recommended procedures to properly operate and maintain the equipment and systems for the expected service life.

B. Qualifications

1. Contractor's instructors shall be factory trained by manufacturer of material or equipment.

2. Contractor's instructors shall be proficient and experienced in conducting training of type required.

3. 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.

C. Scheduling

1. General

a. Contractor shall coordinate training services with startup and initial operation of materials and equipment on days and times and in manner acceptable to Owner in accordance with the Contract Documents.

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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.

c. Prerequisites to Training: Training of Owner's personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01 75 00 – Checkout and Startup Procedures is complete.

2. Training Schedule Submittal

a. Contractor shall prepare and submit proposed training schedule for review and acceptance by Engineer and Owner. Proposed training schedule shall show all training required in the Contract Documents and shall demonstrate compliance with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.

b. Timing: Submit initial training schedule at least 30 days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with Engineer's comments, no later than 7 days prior to starting the first training session.

c. Owner reserves the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

D. Video Recording

1. Contractor shall provide a training specialist for each item of equipment specified to participate in video recording of training.

2. Manufacturer shall grant the ownership rights to Owner to one unedited and one edited copy of the video-recorded training.

3. As an alternative to video-recording training at the Site, the Manufacturer may submit pre-recorded digital media covering the equipment supplied for approval. Submitted pre-recorded digital media shall meet the intent of this Section for approval consideration. If approved, Owner shall have the right to permanent ownership and use of at least one complete copy.

## 1.03 TRAINING REQUIREMENTS

A. General Lesson Plan Requirements

1. Contractor'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.

2. Submit acceptable lesson plan 21 calendar days prior to starting associated training.

3. Lesson plan shall include estimated duration of each training segment.

B. Specific Lesson Plans Requirements

1. Equipment overview shall cover the following:

a. Equipment's operating (process) function, performance objectives, and fundamental operating principles

b. Equipment's mechanical, electrical, and electronic components and features with related components grouped into subsystems and functions of subsystem and subsystem's interaction with other subsystems described

c. Support equipment and appurtenances

d. Safety and potential hazards

e. Safety and control interlocks

2. Operations personnel training shall cover the following:

a. Equipment Overview: As described in this Section

b. Operation

1) Principles, operating, startup, and shutdown procedures

2) Abnormal or emergency startup, operating, and shutdown procedures

3) Alarm conditions and responses

4) Monitoring and recordkeeping

5) Housekeeping

c. Troubleshooting: Required corrective maintenance or an operating parameter adjustment

3. Maintenance Personnel Training

a. Equipment Overview: As described in this Section

b. Equipment Preventive Maintenance

1) Inspection Procedures

a) Operation

b) Trouble symptoms and anticipate breakdowns

c) Predictive maintenance

2) Preventative maintenance intervals

3) Lubricant and replacement parts

4) Cleaning practices and intervals

5) Special tools required

6) Removal, installation, and disassembly and assembly procedures

7) “Hands-on” demonstrations of preventive maintenance procedures

8) Measuring instruments and procedures

9) Torqueing, mounting, calibrating, and aligning procedures and settings requirements

10) Check and test equipment following corrective maintenance.

4. Equipment Troubleshooting

a. Systematic troubleshooting procedures

b. Checklists

c. Testing and diagnostic procedures

d. Corrective maintenance procedures with “hands on” demonstrations

C. Training Aids

1. Contractor’s instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:

a. Audio-visual aids

b. Equipment cutaways and samples

c. Tools, including special tools

2. Podium Presentation Aids: Presentation shall cover equipment, products and materials provided. Provide electronic version of presentation material to Engineer.

   a. Electronic version of presentation aids shall be in Microsoft PowerPoint (.ppt) file format.

   b. Presentation shall include the following sections:

      1) Complete system overview including, but not limited to, related and associated equipment specific to the system

      2) Specific equipment requirements and how equipment functions within the overall system

      3) Site-specific system and equipment requirements

   c. Hardcopy handouts of the electronic presentation aids shall be provided prior to each training section for review during podium presentation.

   d. As an alternative to the electronic presentation, Manufacturer may submit, for approval by the Engineer and the Owner, prerecorded DVD(s) or digital media covering the equipment supplied. Approval of such DVD(s) or digital media shall be contingent upon their content meeting the lesson plan requirement of this Section. If prerecorded DVD(s) or digital media are approved by the Engineer and the Owner, the Owner shall have the right to permanent ownership and use.

3. Handouts

   a. Contractor's instructor shall distribute and use descriptive handouts during training.

   b. Handouts should be coordinated with the instruction.

   c. Provide at least 10 copies of handouts for each training session.

4. Audio-Visual Equipment: Training provider shall provide audio-visual equipment required for training sessions.

## 1.04 SUBMITTALS

A. Action/Informational Submittals

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 timeframes specified in this Section.

2. Lesson Plan: Acceptable lesson plan for training on each material or equipment item in accordance with the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with timeframes specified in this Section.

3. Podium presentation material, electronic version

4. Qualifications: Credentials of Contractor'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.

B. Closeout Submittals

1. Submit trainee sign-in sheet for each training session to Owner's training coordinator.

C. Quality Assurance Submittals

1. Qualifications: Credentials of Contractor'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.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 "HANDS-ON" DEMONSTRATIONS

A. Contractor's instructor shall provide "hands-on" demonstration of operations and maintenance of equipment and materials for each training session.

B. Contractor shall furnish tools and appurtenances required for demonstrations.

### 3.02 SCHEDULE

A. Contractor shall furnish the hours of training and number of sessions indicated at a minimum. Travel time and expenses shall be the responsibility of the manufacturer and are excluded from required training time indicated in the Contract Documents.

B. Owner's operations at the Site occur 24 hours per day, divided into two shifts. Training shall be scheduled in individual 2-hour-long (maximum) sessions during day shift, 8 a.m. to 10 a.m., unless otherwise approved by Engineer, so both shifts can attend the same training session.

C. Training Schedule

| Specification Section/ Division Number | Specification Section/Division Title | Staff | Class-room Hours | Hands-On Hours | Total Session Hours | Number of Sessions | TOTAL HOURS |
|---|---|---|---|---|---|---|---|
| 21 05 00 and 21 13 13 | Basic Fire Suppression Requirements and Wet Pipe Sprinklers | Maintenance and Operations | 0.5 | 0.5 | **1** | 1 | **1** |
| 21 13 24 | Fluorine-Free Foam Fire Suppression System | Maintenance and Operations | 0.5 | 0.5 | **1** | 1 | **1** |
| 43 25 13.10 | Wet Pit Submersible Solids-Handling Pumps | Maintenance and Operations | 0.5 | 0.5 | **1** | 1 | **1** |
| | | Electrical and Instrumentation | 0.5 | 0.5 | **1** | 1 | **1** |
| 46 76 42 | Screw Conveyors | Maintenance and Operations | 0.5 | 0.5 | **1** | 1 | **1** |
| | | Electrical and Instrumentation | 0.5 | 0.5 | **1** | 1 | **1** |
| 46 76 70 | Indirect Thermal Sludge Drying System | Maintenance and Operations | 2 | 8 | **N/A** | 20 | **40** |
| | | Control System Hardware and Software | 2 | 8 | **N/A** | 12 | **24** |
| | | Follow-Up Training | TBD | TBD | **2** | 12 | **24** |

All training session durations (hours) listed for classroom and hands-on sessions are the minimum that shall be provided. If an individual manufacturer typically requires additional training hours as part of their standard training, those additional training hours shall be provided to Owner.

**END OF SECTION**

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## SECTION 01 88 16
## WATERTIGHTNESS TESTING OF CONCRETE STRUCTURES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. All concrete work and sealing work around built-in items and penetrations shall be performed as required to ensure that groundwater, surface water, and water or liquids in tanks, channels, and containers will not intrude into any equipment rooms, pipe galleries, habitable areas, or other generally dry areas.

B. The required watertightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.

C. Each unit shall be tested separately, and the leakage tests shall be made prior to backfilling and before equipment is installed. Testing water shall be from any potable, non-potable, or natural moving source such as a river or stream, but not from any still water source such as a lake or pond or any wastewater source. Use of source water from a river or stream shall be approved in writing by the Authority Having Jurisdiction in advance of its use.

D. All water holding structures shall be tested for leakage by the Contractor. The Contractor shall provide at their own expense all labor, material, temporary bulkheads, pumps, water measuring devices, etc., necessary to perform the required tests.

E. Plant reuse (i.e., final effluent) water will not be available until after the Final Effluent Water Pump Station is constructed and placed into service. Potable water will be available and metered for filling of structures for watertightness testing. If a structure has to be filled more than two times for failed tests, the Contractor shall pay for the potable water required for additional testing.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 23 – Testing Services Furnished by Contractor

B. Section 03 30 00 – Cast-in-Place Concrete

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ACI SPEC-350.1 – Tightness Testing of Environmental Engineering Concrete Structures–Specification

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### 1.04 SUBMITTALS

A. Testing procedures shall be submitted for approval prior to the test.

B. Testing Report: Prior to placing the structure in service, submit for review and approval a detailed report summarizing the watertightness test data, describing the testing procedure, and showing the calculations confirming the test data.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 TEST PREPARATION

A. The design capability of the structure to withstand testing shall be verified for the pressures to be applied. Another type of test shall not be substituted for hydrostatic tightness testing without approval of the Engineer.

B. The structure shall not be tested before all elements of the structure which resist any portion of the retained liquid pressure are in place and the concrete has attained its specified compressive strength.

C. Unless otherwise specified, coatings shall not be applied until after the hydrostatic tightness testing is complete. Liners that are mechanically locked to the surface during the placement of the concrete shall be installed before the hydrostatic tightness testing. Interior liners shall be visually examined for deficiencies (pinholes, tears, and partially fused splices) and must pass integrity testing. Deficiencies shall be repaired.

D. Clean the exposed concrete surfaces of the structure, including the floor, of all foreign material and debris. Prior to testing, standing water in or outside of the structure that would interfere with the inspection of the exposed concrete surfaces of the structure shall be removed.

E. The concrete surfaces and concrete joints shall be thoroughly inspected for potential leakage points. Areas of potential leakage shall be repaired before filling the containment structure with water.

F. All openings, fittings, and pipe penetrations in the structure shall be inspected at both faces of the concrete, if practical. Defective or cracked concrete shall be repaired prior to testing. All structural penetrations and inlet/outlets shall be securely sealed to prevent the loss of water from the structure during the test. All structural penetrations shall be monitored before and during the test to determine the watertightness of these appurtenances. If the structure will be filled using the inlet/outlet pipe, positive means shall be provided to check that water is not entering or leaving through this pipe once the structure is filled to the test level. Leakage at these inlet/outlets shall be repaired prior to testing. No allowance shall be made in test measurements for uncorrected known points of leakage.

G. The flow from any underdrain system, if a system is provided, shall be monitored during this same period, and any increase in flow shall be recorded and considered for information as a part of the hydrostatic tightness testing.

H. The ground water level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.

I. No backfill shall be placed against the walls or on the wall footings of the structure to be tested unless otherwise specified.

**3.02 PROCEDURE**

A. The initial filling of a new structure should not exceed a rate of 4 feet/hour. Filling shall be continued until the water surface is at the design maximum liquid level or either 1 inch below any fixed overflow level in covered containment structures or 4 inches in open structures, whichever is lower.

B. The exterior surfaces of the structure shall be inspected during the period of filling the structure. If any flow of water is observed from the structure exterior surfaces, including joints or cracks, the defect causing the leakage shall be repaired prior to testing.

C. Watertightness Test – Part 1: Qualitative Criteria

1. The water shall be kept at the test level for at least 3 days prior to Part 2 of the testing.

2. The exterior surfaces of the structure shall be observed in both the early mornings and later afternoons during the 3-day period before Part 2 of the test. If any water is observed on the structure exterior surfaces, including joints, repaired honeycombed areas and cracks, where water droplets can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the test.

3. Wet areas on top of wall footing shall not indicate a failure of Part 1 of the test unless the water can be observed to be flowing.

4. Part 2 of the test may begin prior to completion of repairs for Part 1. However, all defects causing the failure of Part 1 shall be repaired before the structure is accepted. The 3-day period of keeping water at the test level shall be observed again after completion of all repairs and prior to acceptance of structure.

D. Watertightness Test – Part 2: Quantitative Criteria

1. The test measurements shall not be scheduled when the weather forecast predicts a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall

also not be scheduled when the weather forecast indicates the water surface could be frozen before the test is completed.

2. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the structure above the water surface. Measurements shall be recorded at 24-hour intervals. Measurements taken at the same time of day will reduce the probability of temperature difference.

3. Measurements shall be taken at two locations, 180° apart, to minimize the possible effect of differential settlement. Measurements shall be taken at the same locations to reduce the probability of measurement differences.

4. The test period shall be at least the theoretical time required to lower the water surface 3/8 inch assuming a loss of water at 0.050% of the water volume per 24-hour period. The test period shall not be longer than 5 days.

5. The water temperature shall be recorded at a depth of 18 inches below the water surface at the start and end of the test.

6. A floating, restrained, partially filled, calibrated, open container for evaporation and precipitation measurement should be positioned in open structures and the water level in the container recorded at 24-hour intervals. Determination of evaporation by a shallow pan-type measuring device is not acceptable due to possible heating of the bottom of the shallow pan resulting in accelerated evaporation.

## 3.03 EVALUATION

A. The containment structure shall continue to be observed in both the early mornings and late afternoons to verify compliance with Part 1 of the test during Part 2.

B. At the end of the test period, the water surface shall be recorded to within 1/16 inch at the location of original measurements. The water temperature and the evaporation and precipitation measurements shall be recorded.

C. The allowable loss of water for tightness tests shall not exceed 0.050% of the test water volume in 24 hours.

D. The change in water volume in the structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature based on the change recorded in the water level from the open container. If the loss exceeds the allowable loss, the structure shall be considered to have failed the test.

E. During Part 2 of the test, observed flow or seepage of water from the exterior surface, including that from cracks and joints, should be considered as a failed test. Excessive wetness resulting in water droplets on dry hand after contact will also be considered a failed test. Slight dampness with only slight wetting of dry hand will not necessarily

qualify as a failed test, depending on application, location, and visibility. Dampness or wetness on top of a footing shall not be considered as a failed test.

## 3.04 RETESTING

A. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.

B. The Contractor shall be permitted to immediately retest when no visible leakage is exhibited. If the structure fails the second test or if the Contractor does not exercise the option of immediately retesting after the first test failure, the interior of the structure shall be inspected by a diver or by other means to determine probable areas of leakage. The structure shall only be retested after the most probable areas of leakage are repaired.

C. If the leakage exceeds the allowable limit, the work shall be corrected by methods approved by the Engineer.

D. Upon completion of the necessary remedial work, the leakage test shall be repeated until it is successfully passed. A minimum of 3 days shall occur between completion of any repairs with water level remaining at required test level without further issues prior to structure being deemed as satisfying all requirements of testing.

## 3.05 NOTIFICATION BY ENGINEER

A. If any leaks greater than the specified amount are not remedied by the Contractor within 4 weeks of notification by the Engineer, regardless of whether the cause of these leaks is or is not determined, the Engineer shall have the authority to have these leaks repaired by others. The cost of repairs, by others, shall be deducted from monies due or to become due to the Contractor.

**END OF SECTION**

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# Cherokee County Water & Sewerage Authority

Fitzgerald Creek Water Pollution Control Plant

# PROJECT MANUAL

## FOR

## Fitzgerald Creek WPCP Thermal Dryer Facility

## November 2025

## BIDDING DOCUMENTS

## VOLUME 2 OF 4

## TECHNICAL SPECIFICATIONS

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# SECTION 02 41 00
# SITE DEMOLITION

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, and equipment in accordance with the requirements of applicable sections of Division 01 – General Requirements and Division 02 – Existing Conditions.

B. In addition, the Contractor shall demolish and remove all concrete and asphalt paving, curbs, sidewalk, and miscellaneous yard piping, utilities, and structures as required and shown on the Contract Drawings during the construction work.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 14 00 – Coordination with Owner's Operations

B. Section 01 42 00 – References

C. Section 01 73 00 – Demolition and Execution of Work

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References shall be in accordance with reference standards, codes, and specifications as set forth herein and in Section 31 10 00 – Clearing, Grubbing, and Site Preparation.

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Copies of all photographs and other records from the joint existing conditions surveys.

## PART 2 – EXECUTION

### 2.01 DEMOLITION

A. Existing concrete and asphalt paving, curbs, sidewalk and miscellaneous yard piping, utilities, and structures within the areas designated for new construction work shall be completely demolished and all debris removed from the site.

05-02-23

B. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris. Select fill or structural fill shall be used where specifically required on Contract Drawings.

C. Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures.

D. Provide all barriers and precautionary measures in accordance with Owner's requirements and other authorities having jurisdiction.

E. Where parts of existing pavements or structures are to remain in service, demolish the portions to be removed, repair damage, and leave the pavement or structure in proper condition for the intended use. Remove asphalt or concrete pavement, concrete, and masonry to the lines designated by saw-cutting, drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcement extends into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.

F. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby pavements and structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims. Contractor shall provide Owner a copy of all records of the joint survey of conditions before demolition activities may begin.

## 2.02 DISPOSAL OF MATERIAL

A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor at a properly permitted facility as part of the work of this Contract. All regulations covering material handling and disposal shall be followed. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at the Contractor’s expense.

B. Burning of any debris resulting from the demolition will not be permitted at the site.

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

# SECTION 03 11 00
# CONCRETE FORMWORK

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 15 00 – Concrete Accessories

B. Section 03 15 16 – Joints in Concrete

C. Section 03 21 00 – Reinforcing Steel

D. Section 03 30 00 – Cast-in-Place Concrete

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia State Minimum Standard Building Code

2. ACI 117 – Specification for Tolerances for Concrete Construction and Materials and Commentary

3. ACI 301 – Specifications for Structural Concrete

4. ACI 318 – Building Code Requirements for Structural Concrete

5. ACI 347 – Recommended Practice for Concrete Formwork

6. U.S. Product Standard for Concrete Forms, Class I, PS 1

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Manufacturer's data on proposed form release agent

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2. Manufacturer's data on proposed formwork system including form ties

## 1.05 QUALITY ASSURANCE

A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

# PART 2 – PRODUCTS

## 2.01 FORMS AND FALSEWORK

A. All forms shall be smooth surface forms unless otherwise specified.

B. Wood materials for concrete forms and falsework shall conform to the following requirements:

1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

## 2.02 FORMWORK ACCESSORIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Sika Corporation or approved equal. Friction fit plugs shall not be used.

C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

## PART 3 – EXECUTION

### 3.01 FORM DESIGN

A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.

B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

### 3.02 CONSTRUCTION

A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

D. Forms shall be mortar tight to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form.

E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.

H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.

I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in

place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

## 3.03 TOLERANCES

A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.

B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.

C. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and benchmarks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

D. Regardless of the tolerances specified, no portion of the structure shall extend beyond the legal boundary of the structure.

## 3.04 FORM ACCESSORIES

A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.

B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to water or enclosed surfaces above the water surface, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03 35 00 – Concrete Finishes. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties

shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

## 3.05 APPLICATION – FORM RELEASE AGENT

A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

## 3.06 INSERTS AND EMBEDDED ITEMS

A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

## 3.07 FORM CLEANING AND REUSE

A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

## 3.08 FORM REMOVAL AND SHORING

A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Contractor shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

**Ambient Temperature (°F) During Concrete Placement**

| | Over 95° | 70°-95° | 60°-70° | 50°-60° | Below 50° |
|---|---|---|---|---|---|
| Edge Forms for Slabs on Grade | 1 day | 1 day | 1 day | 1 day | Do not remove until directed by Engineer (7 days minimum) |
| Walls | 5 days | 2 days | 2 days | 3 days | |
| Columns | 7 days | 2 days | 3 days | 4 days | |
| Beam Soffits | 10 days | 7 days | 7 days | 7 days | |
| Elevated Slabs | 12 days | 7 days | 7 days | 7 days | |

C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.

D. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall always be available for inspection at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

## 3.09 RESHORING

A. When reshoring is permitted or required the operations shall be planned and subjected to approval by the Engineer.

B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.

D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and, in all cases, shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.

E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

**END OF SECTION**

## SECTION 03 15 00
## CONCRETE ACCESSORIES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, crack inducing joint inserts, epoxy bonding agent, and neoprene bearing pads.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 16 – Joints in Concrete

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 07 90 00 – Joint Fillers, Sealants and Caulking

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

2. ASTM D412 – Standard Tests for Rubber Properties in Tension

3. ASTM D471 – Standard Test Method for Rubber Properties

4. ASTM D624 – Standard Test method for Rubber Property - Tear Resistance

5. ASTM D638 – Standard Test Method for Tensile Properties of Plastics

6. ASTM D1171 – Standard Test Method for Ozone Resistance at 500 pphm

7. ASTM D1751 – Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types)

8. ASTM D1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

9. ASTM D2240 – Standard Test for Rubber Property – Durometer Hardness

## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Manufacturer's literature on all products specified herein including material certifications

2. Proposed system for supporting PVC waterstops in position during concrete placement

3. Samples of products if requested by the Engineer

# PART 2 – PRODUCTS

## 2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.

B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.

C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps. of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.

D. The required minimum physical characteristics for this material are:

1. Tensile Strength: 1,750 psi (ASTM D638)

2. Ultimate Elongation: Not less than 280% (ASTM D638)

E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.

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F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.

G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

## 2.02 HYDROPHILIC WATERSTOPS

A. Hydrophilic waterstops shall be designed to expand under hydrostatic conditions. For hydrostatic head pressure greater than 25 feet, waterstops shall be Adeka Ultra Seal MC-2010MN by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak. For hydrostatic head pressure 25 feet or less, Adeka Ultra Seal KBA-1510FP or Hydrotite CJ-1020-2K shall be used. Concrete cover and confinement requirements shall be in accordance with the manufacturer's recommendations.

B. Waterstops shall be fabricated from a chemically modified natural rubber product with a hydrophilic agent. Use of bentonite based waterstop material will not be allowed.

C. Waterstops shall either contain an interior stainless steel mesh or an interior coextrusion of non-hydrophilic rubber to ensure expansion occurs along the width and thickness of the waterstop thereby restricting the expansion in the longitudinal direction.

## 2.03 WATERSTOP ADHESIVE

A. Adhesive between waterstops and existing concrete shall be Neoprene Adhesive 77-198 by JGF Adhesives, Greenstreak® Epoxy-7300 by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond hydrophilic waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-Z by Sika Greenstreak, or approved equal.

## 2.04 JOINT SEALANTS

A. Joint sealants shall comply with Section 07 90 00 – Joint Fillers, Sealants and Caulking.

## 2.05 EXPANSION JOINT MATERIAL

A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:

1. Type I: Sponge rubber, conforming to ASTM D1752, Type I

2. Type II: Cork, conforming to ASTM D1752, Type II

3. Type III: Self-expanding cork, conforming to ASTM D1752, Type III

4. Type IV: Bituminous fiber, conforming to ASTM D1751

## 2.06 EXPANSION JOINT SEAL

A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive, and pressurized during the adhesive cure time.

B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

## 2.07 CRACK INDUCING JOINT INSERTS

A. Crack inducing joint inserts shall be Zip-Cap by Greenstreak Plastic Products, Zip-Joint by BoMetals, Inc.

## 2.08 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterEmaco ADH Series by Master Builders Solutions.

## 2.09 EPOXY RESIN BINDER

A. Epoxy resin binder shall conform to the requirements of ASTM C881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by Master Builders Solutions.

## 2.10 BEARING PADS

A. Neoprene bearing pads shall conform to requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

# PART 3 – EXECUTION

## 3.01 PVC WATERSTOPS

A. PVC waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.

B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.

C. Splices in PVC waterstops and chemical resistant waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.

D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.

E. Retrofit waterstops shall be installed as shown on Drawings using approved waterstop adhesive and Type 316 stainless steel batten bars and expansion anchors.

F. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:

1. Tensile strength less than 80 percent of parent material.

2. Overlapped (not spliced) Waterstop.

3. Misalignment of waterstop geometry at any point greater than 1/16 inch.

4. Visible porosity or charred or burnt material in weld area.

5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

## 3.02 HYDROPHILIC WATERSTOPS

A. Waterstops shall be installed only where shown on the Drawings.

B. Waterstops shall be installed in strict accordance with manufacturer's recommendations.

## 3.03 WATERSTOP ADHESIVE

A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

## 3.04 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.

C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.

E. Type 1 joint sealant shall be used in all expansion and crack inducing joints in concrete, except where other specific types are required as stated below, and wherever else specified or shown on the Drawings. Sealant shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.

G. Type 7 joint sealant shall be used wherever specified or shown on the Drawings.

## 3.05 EXPANSION JOINT SEAL

A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

## 3.06 CRACK INDUCING JOINT INSERTS

A. For joints in slabs, inserts shall be floated in fresh concrete during finishing.

B. For joints in walls, inserts shall be secured in place prior to casting wall.

C. Inserts shall be installed true to line at the locations of all joints as shown on the Drawings.

D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03 15 16 – Joints in Concrete.

E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

## 3.07 EPOXY BONDING AGENT

A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.

B. Bonding surface shall be clean, sound, and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.

C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.

D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

## 3.08 EPOXY RESIN BINDER

A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

## 3.09 BEARING PADS

A. Care shall be taken in fabricating pads and related metal parts so effects detrimental to the proper performance of the pads, such as uneven bearing and excessive bulging, will not occur.

**END OF SECTION**

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## SECTION 03 15 16
## JOINTS IN CONCRETE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENTS

A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.

B. Types of joints in concrete shall be defined as follows:

1. Construction Joints: Intentionally created formed joints between adjacent concrete placements with 100% of reinforcement continuous through joint.

2. Expansion Joints: Formed joints in concrete which separate adjacent sections to allow movement due to dimensional increases and reduction of adjacent sections (temperature and shrinkage). Reinforcement terminates within concrete on each side of joint. Expansion joints may also be considered isolation joints.

3. Contraction Joints: Formed joints in concrete to create interface between concrete placements to allow movement due to dimensional reduction of adjacent sections (shrinkage).

   a. Full Contraction Joints: Formed contraction joints with no bonded reinforcement passing through the joint.

   b. Partial Contraction Joints: Formed contraction joints with no more than 50% of bonded reinforcement passing through the joint.

4. Crack Inducing Joints: Joints formed, tooled, or sawcut in a monolithic placement to create a weakened plane to regulate the location of crack formation due to dimensional reduction of adjacent sections (shrinkage).

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 07 90 00 – Joint Fillers, Sealants and Caulking

## 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. ACI 224.3 – Joints in Concrete Construction

2. ACI 301 – Specifications for Structural Concrete for Buildings

3. ACI 318 – Building Code Requirements for Structural Concrete

4. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Layout drawings showing location and type of all joints to be placed in each structure.

2. Details of proposed joints in each structure.

3. For sawcut crack-inducing joints, submit documentation indicating the following:

   a. Proposed method of sawcutting indicating early entry or conventional sawing.

   b. Description of how work is to be performed including equipment to be utilized, size of crew performing the work and curing methods.

   c. Description of alternate method in case of time constraint issues or failure of equipment.

# PART 2 – MATERIALS

## 2.01 MATERIALS

A. All materials required for joint construction shall comply with Section 03 15 00 – Concrete Accessories and Section 07 90 00 – Joint Fillers, Sealants and Caulking.

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## PART 3 – EXECUTION

### 3.01 CONSTRUCTION JOINTS

A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and proposed location to Engineer for approval. All joints shall be construction joints or expansion joints unless otherwise specified on the Drawings or approved by the Engineer on the joint plan submittal.

B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 50’-0”. For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25’-0”.

D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.

E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

G. Joint plan of walls and slabs shall consider aspect ratio to create placement of sections as close to square as possible. Aspect ratio is defined as the ratio of plan dimensions for slab sections and length to height placement of wall sections. Aspect ratios shall be between 0.65 and 1.5.

### 3.02 EXPANSION JOINTS

A. Size and location of expansion joints shall be as shown on the Drawings. All joints shall be construction joints or expansion joints unless otherwise specified on the Drawings or approved by the Engineer on the joint plan submittal.

B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03 15 00 – Concrete Accessories.

## 3.03 CONTRACTION JOINTS

A. Contraction joints shall be located as shown on the Drawings or otherwise approved by the Engineer on the joint plan submittal. Contractor shall submit proposed locations and details of all contraction joints concurrent or prior to submission of reinforcement drawings. Use of contraction joints at locations not specifically detailed on the Drawings requires Engineer approval and will only be considered if meeting the stipulations herein.

B. Full contraction joints may be considered where the structural behavior of the element allows termination of all reinforcement through joint without compromise of structural integrity of element.

C. Partial contraction joints may be considered where the structural behavior of the element requires partial continuation of reinforcement through joint to ensure structural integrity.

D. Where full contraction joints are allowed, maximum distance between horizontal contraction joints in slab and vertical contraction joints in walls shall be 50’-0”. For exposed walls with fluid or earth on the opposite side, spacing between vertical and horizontal contraction joints shall be a maximum of 25’-0”.

E. Bond breaker shall be provided between sections for all contraction joints.

F. Joint plan of walls and slabs shall consider aspect ratio to create placement of sections as close to square as possible. Aspect ratio is defined as the ratio of plan dimensions for slab sections and length to height placement of wall sections. Aspect ratios shall be between 0.65 and 1.5.

## 3.04 CRACK INDUCING JOINTS

A. Location of crack inducing joints shall be as shown on the Drawings or submitted by Contractor and approved by Engineer.

B. Crack inducing joints shall be formed either by saw cutting, tooling, or use of approved inserts as specified in Section 03 15 00 – Concrete Accessories.

C. If approved by the Engineer, saw cutting of crack inducing joints in lieu of forming or tooling shall conform to the following requirements:

1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.

2. Curing shall be performed using wet curing methods as indicated in Section 03 39 00 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.

3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.

4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.

D. Unless noted otherwise on Drawings, depth of crack inducing joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

## 3.05 JOINT PREPARATION

A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.

C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

D. All joints shall be sealed as shown on the Drawings and specified in Section 03 15 00 – Concrete Accessories.

**END OF SECTION**

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## SECTION 03 21 00
## REINFORCING STEEL

### PART 1 – GENERAL

### 1.01 THE REQUIREMENTS

A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from damage and corrosion in accordance with the requirements of this section.

B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 03 40 00 – Precast Concrete

E. Section 04 20 00 – Unit Masonry

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia State Minimum Standard Building Code

2. CRSI – Concrete Reinforcing Institute Manual of Standard Practice

3. ACI MNL-66 – ACI Detailing Manual

4. ACI 315 – Details and Detailing of Concrete Reinforcing

5. ACI 318 – Building Code Requirements for Structural Concrete

6. WRI – Manual of Standard Practice for Welded Wire Fabric

7. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

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8. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

9. ASTM A1064 – Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

10. ASTM E3121 – Standard Test Methods for Field Testing of Anchors in Concrete or Masonry

## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual (MNL-66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.

2. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual (MNL-66), shall be furnished for all deformed bar reinforcing used in masonry. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, locations, spacing and splicing of the bars.

3. Mill test certificates: Three copies of each.

4. Description of the reinforcing steel manufacturer's marking pattern.

5. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

6. Proposed supports for each type of reinforcing.

7. Request to use splices not shown on the Drawings.

8. Request to weld reinforcement.

9. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' performance, including International Code Council–Evaluation Services Report (ICC-ES ESR).

10. Request for placement of column dowels without the use of templates.

11. Request and procedure to field bend or straighten partially embedded reinforcing.

12. International Code Council–Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

13. Certification that all installers of dowel adhesive systems in horizontal to vertically overhead applications are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

14. Adhesive dowel testing plan.

## 1.05 QUALITY ASSURANCE

A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.

B. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

C. Provide a copy of the current ACI/CRSI Adhesive Anchor Installer certification cards, or equivalent, for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

D. Special inspections for adhesive dowels shall be conducted in accordance with the manufacturer's instructions and Specification Section 01 45 33 – Special Inspections. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

# PART 2 – PRODUCTS

## 2.01 REINFORCING STEEL

A. Bar reinforcing shall conform to the requirements of ASTM A615 for Grade 60 deformed billet-steel reinforcing unless noted otherwise. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type, and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.

1. Reinforcement to be welded shall conform to the requirements of ASTM A706, Grade 60.

2. Reinforcement in Special Moment Frames and Special Structural Walls shall conform to the requirements of ASTM A706, Grade 60 unless ASTM A615, Grade 60 can be shown to meet the following requirements:

   a. Actual yield strength based on mill tests does not exceed fy by more than 18,000 psi.

b. Ratio of the actual tensile strength to the actual yield strength is at least 1.25.

c. Minimum fracture elongation in 8 in. shall be at least 14 percent for bar sizes No. 3 through No. 6, at least 12 percent for bar sizes No. 7 through No. 11, and at least 10 percent for bar sizes No. 14 and No. 18.

d. Minimum uniform elongation shall be at least 9 percent for bar sizes No. 3 through No. 10, and at least 6 percent for bar sizes No. 11, No. 14, and No. 18.

B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A1064 and the details shown on the Drawings.

C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.

D. Use of coiled reinforcing steel will not be allowed.

## 2.02 ACCESSORIES

A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).

B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

## 2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall comply with ACI 318 Type 2 and develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied by the same coupler manufacturer.

C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or

approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.

D. Tension-compression mechanical splices may only be used where shown on the Drawings or where specifically approved by the Engineer. Tension-compression mechanical splices shall be shear screw coupling sleeve type. Acceptable mechanical couplers are Bar Lock L-series or XL-series couplers by Dayton Superior, Dayton, Ohio, or approved equal.

E. Dowel bar mechanical splices shall only be used at construction joints where shown on the Drawings or where specifically approved by the Engineer. Acceptable dowel bar mechanical couplers are the DBDI Splicing System by Dayton Superior, Dayton, Ohio, or approved equal.

F. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece and all components of the coupler system shall be provided by the same coupler manufacturer.

G. Mechanical couplers shall have a valid evaluation report from ICC-ES in accordance with the Building Code.

H. All mechanical couplers shall be installed in accordance with the manufacturer’s recommendations.

## 2.04 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer’s instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer’s requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be dry, or water saturated unless otherwise permitted by the engineer. If water saturated installation is approved, appropriate reduction factors in accordance with manufacturer’s design requirements should be considered. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer’s instructions.

F. Embedment Depth

1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on “Pure 110+” by DeWalt” ESR 3298 issued 7/2020. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer will evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer’s ICC-ES ESR.

3. The embedment depth shall be determined using design parameters listed below. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer’s ICC-ES ESR.

4. Design of adhesive anchor system shall be based on the following parameters:

    a. Actual compressive strength of concrete.

    b. Cracked concrete state.

    c. Dry or water saturated condition for installation.

    d. Base material temperature between 40- and 104-degrees Fahrenheit.

    e. Installation with either a hammer drill with carbide bit or hollow-drill bit system drilling methods.

    f. Minimum age of concrete of 21 days at time of installation.

G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. “SET-3G Epoxy Adhesive Anchors” as manufactured by Simpson Strong-Tie Co. or “Pure 110+ Epoxy Adhesive Anchor System” by DeWalt. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.

I. All individuals installing dowel adhesive systems in horizontal to vertically overhead applications shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program, or equivalent.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.

C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or bent in a manner that will injure the material. Heating of bars will not be permitted.

D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

### 3.02 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall always be protected from the weather by suitable covering. Reinforcing steel shall be stored in an orderly manner and plainly marked to facilitate identification.

C. Reinforcing steel shall always be protected from conditions conducive to corrosion until concrete is placed around it.

D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where delay in depositing concrete occurs, reinforcing shall be inspected again and if necessary recleaned.

### 3.03 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be

used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms to provide the specified concrete coverage.

D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.

E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.

F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

H. Reinforcing shall not be straightened or bent unless specifically shown on the Drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer’s recommendations and as required in Article 2.04 herein. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

J. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI Adhesive Anchor Installer Certification program, or equivalent, per ACI 318-14 17.8.2.2. Current AAI Certificates must be submitted to the Engineer for approval prior to commencement of any adhesive anchor installations.

K. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 10 percent of all adhesive dowels installed shall be tested to 80% of the yield load of the reinforcing bar, with a minimum of one tested dowel per group.

2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values, and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. Proof testing procedures shall be in accordance with ASTM E3121.

3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the load test. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be load tested.

5. When special inspections are not required for the installation, load testing of adhesive dowels shall be performed by an independent testing laboratory retained directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests. If special inspections are required for installation, the independent testing laboratory shall be retained directly by the Owner.

## 3.04 SPLICING

A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.

B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Mechanical splices shall be used only where shown on the Drawings or when approved by the Engineer. Splices shall also meet the requirements of Article 2.03 herein.

E. Mechanical couplers for dowel bar mechanical splices at construction joints which are located at a joint shall be a type which can be set either flush or recessed from the concrete surface. The couplers shall be sealed during concrete placement to eliminate concrete, or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

## 3.05 WELDING OF REINFORCEMENT

A. Welding of reinforcement shall only occur where shown on the Drawings or where specifically approved by the Engineer.

B. Welding shall comply with all requirements of AWS D1.4.

C. Welding shall be performed by certified welders in conformance with AWS D1.4.

D. Material of reinforcement to be welded shall be as specified in Article 2.01, Paragraph A, Item 1.

## 3.06 INSPECTION

A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.

B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

## 3.07 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

**END OF SECTION**

**SECTION 03 30 00**

**CAST-IN-PLACE CONCRETE**

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Provide all labor, equipment, materials, and services necessary for the manufacture, transportation, and placement of all plain and reinforced concrete work, as shown on the Drawings or as required by the Engineer.

B. The requirements in this section shall apply to the types of concrete listed as follows. See Article 2.11 for concrete mix design and properties of concrete.

1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures designed in accordance with ACI 350 including any structures containing water, wastewater or any other fluid, process chemicals, or other materials used in treatment process.

2. Class A2 Concrete: Normal weight structural concrete in all structures other than structures as previously described, and for all sidewalks and pavement.

3. Class A3 Concrete: Normal weight structural concrete to be used for interior slabs where a Type “D” Steel Troweled Finish or Type “G” Hardened Finish is required. Class A3 concrete shall not contain entrained air.

4. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 15 16 – Joints in Concrete

D. Section 03 21 00 – Reinforcing Steel

E. Section 03 35 00 – Concrete Finishes

F. Section 03 39 00 – Concrete Curing

G. Section 03 60 00 – Grout

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## 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia State Minimum Standard Building Code
2. ACI 214 – Guide to Evaluation of Strength Test Results of Concrete
3. ACI 301 – Specifications for Structural Concrete
4. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
5. ACI 305 – Specification for Hot Weather Concreting
6. ACI 306 – Standard Specification for Cold Weather Concreting
7. ACI 309R – Guide for Consolidation of Concrete
8. ACI 318 – Building Code Requirements for Structural Concrete and Commentary
9. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
10. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
11. ASTM C33 – Standard Specification for Concrete Aggregates
12. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
13. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
14. ASTM C88 – Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
15. ASTM C94 – Standard Specification for Ready-Mixed Concrete
16. ASTM C114 – Standard Test Method for Chemical Analysis of Hydraulic Cement
17. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
18. ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete

20. ASTM C150 – Standard Specification for Portland Cement

21. ASTM C157 – Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete

22. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete

23. ASTM C192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

24. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

25. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete

26. ASTM C295 – Standard Guide for Petrographic Examination of Aggregates for Concrete

27. ASTM C457 – Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete

28. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete

29. ASTM C595 – Standard Specification for Blended Hydraulic Cements

30. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

31. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars

32. ASTM C1012 – Standard Test Method for Length Change of Hydraulic Cement Mortars Exposed to a Sulfate Solution

33. ASTM C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

34. ASTM C1157 – Standard Performance Specification for Hydraulic Cement

35. ASTM C1260 – Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)

36. ASTM C1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

37. ASTM C1579 – Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber Reinforced Concrete (Using a Steel Form Insert)

38. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

39. ASTM C1609 – Standard Test Method for Flexural Performance of Fiber Reinforced Concrete (Using Beam with Third-Point Loading)

40. ASTM C1778 – Standard Guide for Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 6 months old) chemical analysis (mill test report) of the Portland Cement or Blended Cement to be used. The chemical analysis must include the equivalent alkali content of the Portland Cement or Blended Cement. For Type IL cement, submit updated cement mill test reports every 6 months while active concrete work is being performed.

3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards (i.e., sieve analysis, potential reactivity, aggregate soundness tests, petrographic analysis, mortar bar expansion testing)

5. Manufacturer's data on all admixtures stating compliance with required standards.

6. Concrete mix design for each class of concrete specified herein.

7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

8. Drying shrinkage test results for Class A1 concrete.

## 1.05 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be required as specified in PART 2 – PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.

B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner. Where field experience records are utilized for mix design verification, submit certified cement chemical analysis (mill test report) for the historical concrete.

C. Field quality control tests, as specified in Article 3.12, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field-Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C1077.

## 1.06 CONCRETE COORDINATION CONFERENCE

A. Unless waived by the Engineer, prior to any concrete submittals and at least 35 days prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting at the Project Site. The purpose of the meeting is to review the proposed concrete mix designs, to discuss the proposed approaches and procedures for mixing, transporting, placing, testing, finishing, and curing of all aspects of concrete work to ensure the concrete construction is performed in accordance with the Specifications, and to clarify roles of the parties involved. The Contractor shall send a concrete coordination conference agenda to all attendees 20 days prior to a mutually agreed upon date for the conference.

B. As a minimum the agenda shall include:

1. Concrete Materials and Mix Designs
2. Inspection Responsibilities
3. Concrete Sampling and Testing Specification Requirements
4. Cylinder Storage and Transportation
5. Acceptance/Rejection Responsibility and Authority for Fresh Concrete
6. Concrete finishing
7. Concrete Curing
8. Test Report Distribution
9. Miscellaneous Items

C. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent

2. Engineer

3. Owner's representative (if they chose to attend)

4. Laboratory retained for trial batching and construction quality control testing for the concrete.

5. Any subcontractors involved in placing, finishing, and curing of concrete.

6. Concrete supplier

7. Concrete pumping subcontractor (if pumping is being proposed)

D. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all attendees and any other concerned parties within 5 days of the meeting.

## PART 2 – PRODUCTS

### 2.01 NSF/ANSI STANDARD 61 CERTIFIED CONCRETE (NOT USED)

### 2.02 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.03 or 2.04, respectively.

2. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

3. Portland Cement shall also meet performance requirements of ASTM C1157.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement), Type IS (Portland Slag Cement), or Type IL (Portland Limestone Cement) conforming to ASTM C595.

2. Type IP cement shall be an inter-ground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

3. Type IS cement shall be an inter-ground blend of Portland Cement and slag cement in which the slag cement constituent is between 30% and 40% of the weight of the total blend.

4. Type IL cement shall be an inter-ground blend of Portland Cement and limestone in which the limestone constituent is between 5% and 15% of the weight of the total blend.

5. Fly ash, slag cement, and limestone used in the production of blended cements shall meet the requirements of Articles 2.03, 2.04, and 2.05 respectively.

6. Cements meeting ASTM C1157 shall not be used in manufacture of blended cements.

7. Blended cement shall meet the Physical Requirements of Tables 2 and 3 of ASTM C595 including the requirements for high sulfate resistance in Table 3 as tested per ASTM C1012.

C. Different types of cement shall not be mixed, nor shall they be used alternately except when authorized in writing by the Engineer. For Type IP, Type IS or Type I/II cement, different brands of cement or the same brand from different mills may be used alternately. For Type IL cement, use of a different cement brand or same brand from a different mill requires resubmittal of the mix design with current mill test report for review. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

**2.03 FLY ASH**

A. Fly ash shall meet the requirements of ASTM C618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C618. Fly ash shall be considered as a supplemental cementitious material.

B. For fly ash to be used in the production of Type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C595.

C. Where reactive aggregates as defined in Article 2.08 are used in the concrete mix, the fly ash constituent shall be as needed to satisfy the concrete alkali loading requirements stipulated in Article 2.06. The percentage of fly ash shall also be set to meet the mean

mortar bar expansion requirements in provisions of Article 2.08.G.2. Where fly ash is used, the minimum fly ash content shall be 15%.

D. For Type A1 concrete as required for use in environmental concrete structures, i.e., process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

## 2.04 SLAG CEMENT

A. Slag cement shall meet the requirements of ASTM C989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C989.

B. Where reactive aggregates as defined in Article 2.08 are used in concrete mix, the slag cement constituent shall be as needed to satisfy the concrete alkali loading requirements stipulated in Article 2.06. The percentage of slag cement shall also be set to meet the mean mortar bar expansion requirements in provisions of Article 2.08.G.2. Where Slag Cement is used, the minimum Slag Cement content shall be 30%, and the maximum Slag Cement content shall be 40%.

C. For Type A1 concrete as required for use in environmental concrete structures, i.e., process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

D. Additional slag cement shall not be included in concrete mixed with Type IS or IP cement.

## 2.05 PORTLAND LIMESTONE CEMENT (TYPE IL)

A. Portland Limestone Cement (Type IL) cement shall meet the requirements of ASTM C595.

B. Limestone used for blended cement Type IL shall be naturally occurring and meet the requirements of ASTM C33.

C. Fly ash or slag cement shall be used with Type IL cement to meet requirements for durability, ASR resistance, sulfate resistance, and use for environmental structures, as specified herein.

## 2.06 CONCRETE ALKALI LOADING

A. All concrete mixes containing potentially reactive aggregates shall have a maximum alkali loading of the concrete of 3.0 pounds per cubic yard.

B. The alkali loading of concrete is the Portland Cement equivalent alkali content multiplied by the Portland Cement content of the mix in pounds per cubic yard divided by 100. The Portland Cement equivalent alkali content shall be included in the certified chemical analysis of the Portland Cement.

C. Means of evaluating alkali loading of concrete and proportioning constituents of concrete to minimize alkali loading of content shall also conform to the guidelines of ASTM C1778.

## 2.07 WATER

A. Water used for mixing concrete shall be clear, potable, and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts, and other impurities.

B. Water shall not contain more than 100 PPM chloride.

C. Water shall not contain more than 500 PPM dissolved solids.

D. Water shall have a pH in the range of 4.5 to 8.5.

E. Water shall meet requirements of ASTM C1602.

## 2.08 AGGREGATES

A. All aggregates used in normal weight concrete shall conform to ASTM C33.

B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel, or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C33 unless otherwise specified.

D. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C136.

E. Aggregates shall be tested for soundness in accordance with ASTM C88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

F. All aggregates shall be evaluated in accordance with ASTM C1778 to determine potential reactivity. All aggregates shall be considered reactive unless they meet the following requirements for non-reactive aggregates. Aggregates with a lithology like

sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the previously described tests.

1. Non-reactive aggregates shall meet the following requirements:

    a. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

        1) Optically strained, micro-fractured, or microcrystalline quartz, 5.0%, maximum.

        2) Chert or chalcedony, 3.0%, maximum.

        3) Tridymite or cristobalite, 1.0%, maximum.

        4) Opal, 0.5%, maximum.

        5) Natural volcanic glass in volcanic rocks, 3.0%, maximum.

2. Concrete mixed with reactive aggregates shall meet the following requirements:

    a. If aggregates are deemed potentially reactive as per ASTM C1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.

    b. If aggregates are deemed potentially reactive as per ASTM C1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.

    c. If the proposed aggregates are deemed potentially reactive, the concrete mix shall be evaluated and confirmed to meet the requirements for concrete alkali loading as stipulated in Article 2.06.

G. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

## 2.09 SYNTHETIC FIBERS (NOT USED)

## 2.10 ADMIXTURES

A. Admixtures containing intentionally added chlorides shall not be used.

B. Admixtures containing 1,4 Dioxane shall not be used in Projects located in a state where 1,4 Dioxane limits are required.

C. Air entraining admixture shall be added to all concrete unless noted otherwise. The air entraining admixture shall conform to ASTM C260. The admixture proposed shall be selected in advance so that adequate samples may be collected, and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

D. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set, and enhancing durability. Admixtures permitted shall confirm to the requirements of ASTM C494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are “Eucon Series” by the Euclid Chemical Company, “Master Pozzolith Series or Master Polyheed Series” by Master Builders Solutions, and “Plastocrete Series” by Sika Corporation.

2. High range water reducer shall conform to ASTM C494, Type F or G. The high range water reducer shall be added to the concrete at the batch plant and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured, and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day’s operation of the Project Site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are “Eucon 37” or Plastol 5000 by the Euclid Chemical Company, “Master Rheobuild 1000 or Master Glenium Series” by Master Builders Solutions, and “Daracem 100 or Advaflow Series” by W.R. Grace.

3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type C or E. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year’s duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are “MasterSet AC 534 or MasterSet FP 20” by Master Builders Solutions, “Accelguard 80/90 or NCA” by the Euclid Chemical Company and “Daraset” by W.R. Grace.

4. A retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type B or D. Acceptable products are “Eucon NR or Eucon Retarder 100” by the Euclid Chemical Company, “MasterSet R Series or MasterSet DELVO Series” by Master Builders Solutions, and “SikaTard®-440” by Sika Corporation.

5. Workability Retaining Admixture shall conform to ASTM C494, Type S. The admixture shall retain concrete workability without affecting time of setting or early-age strength development. Acceptable products are “MasterSure Z 60” by Master Builders Solutions, ViscoFlow-2020 by Sika Corporation, PLASTOL AMP-X3 by Euclid Chemical Company, or equal.

E. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

F. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

## 2.11 CONCRETE MIX DESIGN

A. The proportions of cement, aggregates, admixtures, and water used in the concrete mixes shall be based on laboratory trial mixes in conformance with ACI 301. Trial mixes shall also conform to Article 3.01 of this Section. Trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

| | |
|---|---|
| Concrete Class A1, A2, A3 | 4,500 psi (min), 6,500 psi (max) |
| Concrete Class B | 3,000 psi (min), 5,000 psi (max) |

2. Water/cementitious materials ratio, by weight

| | **Maximum** | **Minimum** |
|---|---|---|
| Concrete Class A1, A2, A3 | 0.42 | 0.39 |
| Concrete Class B | 0.50 | 0.39 |

3. Slump range

a. 4" nominal unless high range water reducing admixture is used.

b. 10” max if high range water reducing admixture is used.

4. Air Content

| | |
|---|---|
| Concrete Class A1, A2 | 6% +/-1.5% |
| Concrete Class A3, B | 3% Max (non-air-entrained) |

## PART 3 – EXECUTION

### 3.01 TRIAL MIXES

A. Trial mixes shall be used to confirm the quality of a proposed concrete mix in accordance with ACI 301. An independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement, supplementary cementitious materials, and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated as follows. Tests on individual materials stated in PART 2 - PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

B. The independent testing laboratory shall prepare a minimum of 15 standard test cylinders in accordance with ASTM C31 in addition to conducting slump (ASTM C143), air content (ASTM C231) and density (ASTM C138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C39 as follows: Test three cylinders at age 7 days; test three cylinders at age 21 days; test three cylinders at age 28 days and test three cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. __“. If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

### 3.02 FIELD EXPERIENCE RECORDS

A. When field experience records are provided in lieu of trial mixes for proposed concrete mixes, field experience records shall meet the following criteria:

1. Field experience records shall have been obtained within the past 24 months from project Notice to Proceed and shall have occurred over a duration of no less than 45 calendar days.

2. Field experience records shall be based on data from a single group of at least 15 consecutive compressive strength tests or two groups of consecutive compressive strength tests totaling at least 30 tests with neither of the two groups consisting of fewer than 10 tests.

3. Concrete for field experience records shall have the same mix proportions and properties as the proposed concrete mix, including compressive strength and air content within a range of 4.5% to 7.5%.

4. Concrete for field experience records shall have identical material sources as the proposed concrete mix. These materials shall include cement, fly ash, slag cement, coarse aggregates, fine aggregates, and admixtures.

5. If all criteria for field experience records cannot be met, the contractor shall perform trial mixes for the proposed concrete mixes.

## 3.03 SHRINKAGE TESTS (NOT USED)

## 3.04 PRODUCTION OF CONCRETE

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready-mix concrete plant or from a Site-mixed plant. In selecting the source for concrete production, the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete

1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C94.

2. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to

consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the Project Site for the work and discharge shall be completed within the time requirements stated in Article 3.05 of this Section.

6. Every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

    a. Date and truck number

    b. Ticket number

    c. Mix designation of concrete

    d. Cubic yards of concrete

    e. Cement brand, type, and weight in pounds

    f. Weight in pounds of fine aggregate (sand)

    g. Weight in pounds of coarse aggregate (stone)

    h. Air entraining agent, brand, and weight in pounds and ounces

    i. Other admixtures, brand, and weight in pounds and ounces

    j. Water, in gallons, stored in attached tank

    k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio

    l. Water, in gallons, used (by truck driver)

    m. Time of loading

    n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the Project Site which is not accompanied by a delivery ticket showing the previously listed information will be rejected and such truck shall immediately depart from the Project Site.

8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to inspection at the batching plant by the Engineer.

C. Site-Mixed Concrete

1. Site-mixed concrete shall only be used where specifically approved by the Engineer.

2. Scales for weighing concrete ingredients shall be accurate when in use within ±0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

3. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

   a. Cement, Fly Ash, or Slag Cement: +/-1 percent

   b. Water: +/-1 percent

   c. Aggregates: +/-2 percent

   d. Admixtures: +/-3 percent

4. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

5. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.

6. Mixers with a rated capacity of 1 cubic yard or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.

7. Except as provided as follows, batches of one cubic yard or less shall be mixed for not less than one minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

8. Shorter mixing time may be permitted provided performance tests made in accordance with ASTM C94 indicate that the time is sufficient to produce uniform concrete.

9. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.

10. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.

11. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if recommended by the manufacturer.

12. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

13. Addition of retarding admixtures shall be completed within one minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

14. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C94.

## 3.05 CONCRETE PLACEMENT

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice, and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of

placement, allowing sufficient time for a concurrent inspection and for any corrective measures required.

C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix meeting all specified requirements.

F. Concrete shall be conveyed as rapidly as practical to the point of deposit by methods which prevent the separation or loss of the ingredients. The concrete shall be deposited so that additional handling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates unless workability-retaining admixtures are included and approved by the Engineer. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.11 of this Section.

G. Where concrete is conveyed to position by chutes, a continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds.

I. Placing of concrete shall be regulated so the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable

hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed 5 feet, and enough tremies shall be placed in the form to ensure the concrete remains level.

K. When placing concrete which will be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.

L. Concrete shall be placed to thoroughly embed all reinforcement, inserts, and fixtures.

M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. Concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.

N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. Vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration shall not be continued in any one location to the extent that pools of grout are formed.

P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall ensure that each layer is placed while the previous layer is soft or plastic, so the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators to ensure complete filling

under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and water stops, and/or any proposed deviations from the stated requirements to the Engineer for review and approval.

S. Concrete shall not be placed during rains sufficiently heavy or prolonged to prevent washing of mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

## 3.06 PLACING FLOOR SLABS ON GROUND

A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the Specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.

B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, the temperature shall be raised and maintained above 50° long enough to remove all frost from the subgrade.

C. The subgrade shall be moist at the time of concreting. If necessary, the subgrade shall be dampened with water in advance of concreting, but no free water shall remain standing on the subgrade nor any muddy or soft spots when the concrete is placed.

D. Thirty-pound felt-paper shall be provided between edges of slabs-on-ground and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.

E. Contraction joints shall be provided in slabs-on-ground at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03 15 16 – Joints in Concrete.

F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03 35 00 – Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

## 3.07 PLACING CONCRETE UNDERWATER (CLASS A5 CONCRETE) (NOT USED)

## 3.08 PLACING CONCRETE UNDER PRESSURE

A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall produce a continuous stream of concrete without air pockets. To obtain the least line resistance, the layout of the pipeline system shall contain minimum bends with no

change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.

C. No aluminum parts shall be in contact with the concrete during the placing of concrete under pressure.

D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated Site conditions from beginning to end. The batching and truck mixing shall be the same as will be used during construction, and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.

E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the Project Site during pumping.

G. The minimum diameter of the hose (conduits) shall be 4 inches.

H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

I. Concrete samples for quality control in accordance with Article 3.12 will be taken at the placement (discharge) end of the line.

## 3.09 ORDER OF PLACING CONCRETE

A. To minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

## 3.10 CONCRETE WORK IN COLD WEATHER

A. Cold weather concreting procedures shall conform to the requirements of ACI 306.1.

B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed these minimum values by more than 20°F, unless otherwise approved by the Engineer.

C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature greater than 100°F. to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

## 3.11 CONCRETE WORK IN HOT WEATHER

A. Hot weather concreting procedures shall conform to the requirements of ACI 305.1.

B. When air temperatures exceed 85°F., or when extremely dry or high wind conditions exist even at lower temperatures, the Contractor and the Contractor’s concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing, and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation, and the Engineer reserves the right to modify the proposed measures consistent with the requirements herein. All necessary materials and equipment shall be in place prior to each placing operation.

C. Preparatory work at the Project Site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.

D. The temperature of the concrete mix when placed shall not exceed 95°F.

E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the Project Site being considered. Stockpiled aggregates shall be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, the ice must be entirely melted prior to addition of the water to the dry mix.

F. Delivery schedules shall be carefully considered in advance to ensure concrete is placed as soon as practical after mixing. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within

60 minutes from the time the concrete is batched, unless workability-retaining admixtures are included and approved by the Engineer.

G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

## 3.12 QUALITY CONTROL

A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's Resident Project Representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.

2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall assist the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material, or labor costs due to such occurrences.

2. Slump tests shall be made in accordance with ASTM C143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. Concrete with a specified nominal slump shall be placed having a slump within 1” (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Density

1. Samples of freshly mixed concrete shall be tested for density by the materials testing consultant in accordance with ASTM C138.

2. Density tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C231.

2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C172, C31, and C39, except as modified herein.

2. In general, one sampling shall be taken for each placement more than 5 cubic yards, with a minimum of one sampling for each day of concrete placement operations, or for each 100 cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater. If total volume of concrete is such that frequency of testing would provide fewer than five strength tests for a given concrete class, strength test specimens shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.

3. Each sampling shall consist of at least five 6x12 cylinders or eight 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy themselves that such information shown is correct.

4. The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders. The Contractor shall provide approved curing boxes for storage of cylinders on Site. The insulated curing box shall be of sufficient size and strength to contain all the cylinders made in any four consecutive working days and to protect the specimens from falling over, being jarred, or otherwise disturbed during the period of initial curing. The box shall be erected, furnished, and maintained by the Contractor. The box shall be equipped to provide the moisture conditions and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C31. The curing box shall be placed in an area free from vibration such as pile driving and traffic of all kinds and such that all cylinders are shielded from direct sunlight and/or radiant heating sources. No concrete requiring testing shall be delivered to the Project Site until the storage curing box has been provided. Cylinders shall remain undisturbed in the curing box until ready for delivery to the testing laboratory, but not less than 16 hours.

5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of cylinders with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day the curing box contains cylinders. Temperature shall be recorded a minimum of three times a day with one recording at the start of the day and one recording at the end of the day.

6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

7. Compression tests shall be performed in accordance with ASTM C39. For 6x12 cylinders, two test cylinders will be tested at 7 days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at 7 days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.

2. The strength level of concrete will be considered satisfactory if the following conditions are satisfied.

    a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.11).

    b. No individual compressive strength test result falls below the minimum specified strength by more than 500 psi.

3. If any of the previously listed conditions are not met, the mix proportions shall be corrected for the next concrete placing operation.

4. If condition 3.12.F.2.b is not met, additional tests in accordance with Article 3.12, Paragraph H shall be performed.

5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:

    a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.

    b. Maintain or add temporary structural support as required.

c. Correct the mix for the next concrete placement operation, if required to remedy the situation.

6. All concrete which fails to meet the ACI requirements, and these specifications is subject to removal and replacement at no additional cost to the Owner.

G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

H. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.

2. If the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.12, Paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.

a. Three cores shall be taken for each sample in which the strength requirements were not met.

b. The drilled cores shall be obtained and tested in conformance with ASTM C42. The tests shall be conducted by a materials testing consultant approved by the Engineer.

c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.

d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.

e. The diameter of core specimens should be at least 3 times the maximum nominal size of the coarse aggregate used in the concrete but must be at least 2 inches in diameter.

f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.

g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.

h. Two copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from

a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

3. If the concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM C457.

## 3.13 CARE AND REPAIR OF CONCRETE

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.

B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.

C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.

D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.

E. Concrete which fails to meet the strength requirements as outlined in Article 3.12, Paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses, and exposure conditions for the area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

**END OF SECTION**

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# SECTION 03 35 00
# CONCRETE FINISHES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 03 39 00 – Concrete Curing

D. Section 03 60 00 – Grout

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI SPEC-301 – Specifications for Structural Concrete

2. ACI CODE-318 – Building Code for Structural Concrete–Code Requirements and Commentary

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Manufacturer's literature on all products specified herein.

## PART 2 – PRODUCTS

### 2.01 CONCRETE FLOOR SEALER

A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by Master Builders Solutions.

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## 2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing siliconate based solution designed to harden, dustproof, and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is siliconate. Acceptable products are Diamond Hard by the Euclid Chemical Company, and Seal Hard by L&M Construction Chemicals, and Masterkure HD 200 WB by Master Builders Solutions.

## 2.03 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

A. Non-oxidizing heavy-duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or MasterTop 200 by Master Builders Solutions.

## 2.04 NON-SLIP FLOORING ADDITIVE

A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be MasterTop 120SR by Master Builders Solutions, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

# PART 3 – EXECUTION

## 3.01 FINISHES ON FORMED CONCRETE SURFACES

A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.06 – CONCRETE FINISH SCHEDULE. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. See Article 3.05 for surfaces to receive paint or protective coatings. The Engineer will be the sole judge of acceptability of all concrete finish work.

1. Type I - Rough: All fins, burrs, offsets, marks, and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than ¼-inch. All holes left by removal of ends of ties, and all other holes, depressions, bug holes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than 1/4 inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one-part cement

to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been pre-dampened over an extended amount of time to reach the condition of saturated surface dry (SSD), a slurry consisting of one part cement (including an appropriate quantity of white cement to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.

3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded using a carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

## 3.02 SLAB AND FLOOR FINISHES

A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.06 – CONCRETE FINISH SCHEDULE. The Engineer will be the sole judge of acceptability of all such finish work.

1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2” minimum deep grooves prior to final set.

2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than the finish obtained with a wood float. The finish shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.

6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout with inclusion of macro-synthetic fibers in accordance with Section 03 60 00 – Grout shall be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.

   Type “G” Hardened Finish: This finish shall be applied after completion of a Type “B” or Type “C” finish and prior to application of a Type “D” finish. Hardeners shall be applied in strict accordance with the manufacturer’s requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type “D” finish shall be applied following completion of application of the hardener. Non-oxidizing, heavy-duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Drawings or specified herein at the rate of 1.5 pounds/SF.

7. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with

manufacturer's instructions. Finish shall be applied where specifically required on the Drawings or specified herein.

8. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of +/-1/4 inch.

## 3.03 CONCRETE SEALERS

A. Concrete sealers shall be applied where specifically required on the Drawings or specified herein. Concrete sealers and densifiers shall not be used as concrete curing compounds. Curing compounds, when allowed, shall be in accordance with Section 03 39 00 – Concrete Curing.

B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer’s requirements.

C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.

D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.

E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

## 3.04 FINISHES ON EQUIPMENT PADS

A. Formed surfaces of equipment pads shall receive a Type III finish.

B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

## 3.05 FINISHES FOR SURFACES TO RECEIVE PAINT OR COATINGS

A. Surfaces indicated or specified to receive paint or special coatings shall be prepared per Division 09 – Finishes. All products applied to the concrete surfaces during the placement, finishing, and curing process shall be compatible with the painting or coating system as required by the manufacturer.

## 3.06 CONCRETE FINISH SCHEDULE

| Item | Type of Finish |
|---|---|
| Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures: | |
| From 1 feet below water surface to bottom of wall | I |
| From top of wall to 1 feet below water surface | II |
| Exterior concrete walls below grade | I |
| Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures, and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere | II |
| All interior exposed concrete walls and vertical surfaces | III |
| Floors of process equipment tanks or basins, wetwells, flow channels and slabs to receive roofing material or waterproof membranes | B |
| All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet | D or E *PM/Engineer to discuss with Client. |
| All interior finish floors of buildings and structures which are not continuously or intermittently wet | D |
| Floors to receive tile, resilient flooring, or carpeting | D |
| Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather | E |
| Garage, storage area floors, and loading docks | G |

**END OF SECTION**

## SECTION 03 39 00
## CONCRETE CURING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 30 00 – Cast-In-Place Concrete

C. Section 03 35 00 – Concrete Finishes

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. ACI 301 – Specifications for Structural Concrete
2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
3. ACI 305.1 – Specification for Hot Weather Concreting
4. ACI 306.1 – Standard Specification for Cold Weather Concreting
5. ACI 308.1 – Specification for Curing Concrete
6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete
7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

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## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Proposed procedures for protection of concrete under wet weather placement conditions

2. Proposed normal procedures for protection and curing of concrete

3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions

4. Proposed method of measuring concrete surface temperature changes

5. Manufacturer's literature and material certification for proposed curing compounds

# PART 2 – PRODUCTS

## 2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m2 when applied at manufacturer’s recommended volume for square feet of area. Manufacturer’s certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company.

B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C309. Acceptable products are “Kurez DR VOX” by the Euclid Chemical Company or “Cristallum” by W. R. Meadows, Inc. Install in strict accordance with manufacturer’s requirements.

## 2.02 EVAPORATION REDUCER

A. Evaporation reducer shall be "MasterKure ER 50” by Master Builders Solutions, or "Euco-Bar" by Euclid Chemical Company.

# PART 3 – EXECUTION

## 3.01 PROTECTION AND CURING

A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.

B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provisions shall be made for maintaining the concrete in a moist

condition for at least a 7-day period thereafter, except for high early strength concrete, for which the period shall be at least the first 3 days after placement. Horizontal surfaces shall be kept covered, and intermittent, and localized drying will not be permitted.

C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of 7 days. Use of a curing compound will not be acceptable for applications of this type.

D. The Contractor shall use one of the following methods to ensure that the concrete remains in a moist condition for the minimum period stated above.

1. Ponding or continuous fogging or sprinkling.

2. Application of mats or fabric kept continuously wet.

3. Continuous application of steam (under 150°F).

4. Application of sheet materials conforming to ASTM C171.

5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.

E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in Paragraph D of Article 3.01.

F. Any of the curing procedures used in Paragraph D of Article 3.01 may be replaced by one of the other curing procedures listed in Paragraph D of Article 3.01 after the concrete is 1 day old. However, the concrete surface shall not be permitted to become dry at any time.

## 3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03 30 00 – Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.

B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or slag cement. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.

D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

## 3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sunshades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.

C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in Paragraph D of Article 3.01 is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.

D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least 6 additional days using one of the methods listed in Paragraph D of Article 3.01.

E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

## 3.04 USE OF CURING COMPOUND

A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of 7 days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF 61.

B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time, and the subsequent appearance of the concrete surface shall not be affected.

C. The compound shall be applied in strict accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Coverage rates for the curing and sealing compound shall be in strict accordance with manufacturer’s requirements for the specific type of finish required. For rough surfaces, apply in two directions at right angles to each other.

**END OF SECTION**

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# SECTION 03 40 00
# PRECAST CONCRETE

## PART 1 – GENERAL

### 1.01 REQUIREMENTS

A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 21 00 – Reinforcing Steel

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 03 35 00 – Concrete Finishes

D. Section 03 39 00 – Concrete Curing

E. Section 03 60 00 – Grout

F. Section 05 05 13 – Galvanizing

G. Section 05 05 23 – Metal Fastening

H. Section 05 10 00 – Metal Materials

I. Section 33 05 61 – Utility Structures

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid:

1. Georgia State Minimum Standard Building Code

2. ACI 301 – Structural Concrete for Buildings

3. ACI 318 – Building Code Requirements for Structural Concrete

4. ASTM D2240 – Standard Test for Rubber Property – Durometer Hardness

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5. PCI Standard MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

6. PCI Standard MNL-120 - Design Handbook Precast and Prestressed Concrete

7. PCI Standard MNL-123 – Manual on Design of Connections for Precast Prestressed Concrete

8. PCI Standard MNL-124 – PCI Design for Fire Resistance of Precast Prestressed Concrete

## 1.04 SUBMITTALS

A. The Contractor shall submit the following for review in accordance with Section 01 33 00 – Submittal Procedures:

1. Shop Drawings for all precast members including layout and dimensions, unit locations, unit identification marks, reinforcement connection details, support items, dimensions, openings, temporary supports, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions. The submittal shall be sealed by a Professional Engineer currently registered in the state of Georgia.

2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item and assumptions, shall be submitted. Calculations shall be sealed by a Professional Engineer currently registered in the in the state of Georgia.

4. Certified reports for all lifting inserts, indicating allowable design loads.

5. Information on lifting and erection procedures.

## 1.05 QUALITY ASSURANCE

A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing, and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer will have the option of rejecting any or all the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

B. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years' experience in precast concrete work.

D. Erector of precast and prestressed items shall be a company specializing in erecting members specified with a minimum of three years documented experience and specifically approved by the fabricator of precast and prestressed members specified.

## PART 2 – PRODUCTS

### 2.01 DESIGN REQUIREMENTS

A. Precast and prestressed members shall be designed to support superimposed loads indicated on the Drawings and as required by governing Building Code. Design shall also consider loads and stresses due to handling, transporting, and erecting of units.

B. Maximum live load deflections for members shall be L/240 for roof members and L/360 for floor members.

C. Members shall be designed to accommodate construction tolerances, and clearances of intended openings.

D. Design shall be performed by a qualified professional engineer registered in the state of Georgia.

E. Fire Rating shall be established in accordance with PCI MNL 124 to achieve the fire ratings required on the Drawings for floor, wall, and roof assemblies.

### 2.02 CONCRETE

A. Concrete materials including Portland cement, aggregates, water, and admixtures shall conform to Section 03 30 00 – Cast-in-Place Concrete. Precast concrete manufacturer has option of using Type III cement for prestressed concrete members to expedite release of prestressing and erection.

B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4,500 psi for fluid containing and other environmental concrete structures and 4,000 for other structural concrete structures, unless otherwise specified.

## 2.03 GROUT

A. Grout for joints between members shall be a cement grout in conformance with Section 03 60 00 – Grout.

B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

## 2.04 REINFORCING STEEL

A. Reinforcing steel used for precast concrete construction shall conform to Section 03 21 00 – Reinforcing Steel.

## 2.05 PRESTRESSING STRANDS (NOT USED)

## 2.06 STEEL INSERTS

A. Steel inserts shall be in accordance with Section 05 10 00 – Metal Materials.

B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05 05 13 – Galvanizing.

## 2.07 WELDING

A. Welding shall conform to Section 05 05 23 – Metal Fastening.

## 2.08 BEARING PADS

A. Neoprene bearing pads shall conform to the requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

## PART 3 – EXECUTION

### 3.01 FABRICATION AND CASTING

A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true, and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position. Form materials shall be steel and the systems free from leakage during the casting operation.

B. Manufacturer shall maintain plant records and quality control program during production of precast members.

C. Ensure reinforcing steel anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Openings with a 10-inch minimum dimension in either direction shall be cast in place. Smaller openings shall be considered in the design and arrangement of reinforcement and strands. These openings may be field cut, but only in the size and location approved by the precast manufacturer.

E. All cover of reinforcing shall be the same as detailed on the Drawings.

F. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.

G. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.

H. Concrete shall be finished in accordance with Section 03 35 00 – Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.

I. Curing of precast members shall be in accordance with Section 03 39 00 – Concrete Curing. Use of a membrane curing compound will not be allowed.

J. The manufacturer shall provide lifting inserts or other approved means of lifting members.

## 3.02 HANDLING, TRANSPORTING AND STORING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28-day compressive strength and a period of at least 5 days has elapsed since casting.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.

D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.

E. Precast concrete members shall not be used as storage areas for other materials or equipment.

F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

## 3.03 ERECTION

A. Erection shall be carried out by the manufacturer or under the manufacturer's supervision using labor, equipment, tools, and materials required for proper execution of the work.

B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.

C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.

D. Connections which require welding shall be properly made in accordance with Section 05 05 23 – Metal Fastening.

E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.

F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on

the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).

G. No Contractor, Subcontractor or any of their employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.

H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

**END OF SECTION**

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## SECTION 03 60 00
## GROUT

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 01 – General Requirements and Division 02 – Existing Conditions of these Specifications.

B. Section 03 30 00 – Cast-In-Place Concrete

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. CRD-C621 – Corps of Engineers Specification for Non-shrink Grout

2. ASTM C33 – Standard Specification for Concrete Aggregates

3. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)

4. ASTM C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings

5. ASTM C579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings

6. ASTM C827 – Standard Test Method for Early Volume Change of Cementitious Mixtures

7. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

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## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein

2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of grout used in the work

## 1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.

   a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at 7 days, 28 days, and any additional times as appropriate.

   b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at 7 days and any other time as appropriate.

2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.

3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one-part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4,000 psi.

3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness. Cement grout used for surfaces swept in by a mechanism shall also contain macro-synthetic fibers in accordance with Section 03 30 00 – Cast-In-Place Concrete.

4. Sand shall conform to the requirements of ASTM C33.

5. Cement grout for exterior, exposed applications shall contain 6% +/-1.5% air content. See Section 03 30 00 – Cast-In-Place Concrete for air entraining admixture requirements.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C621 and ASTM C1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a minimum 28-day strength of 7,000 psi. Non-shrink grout shall be, "NS Grout" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “MasterFlow 928” by Master Builders Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "E3 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by Master Builders Solutions.

2. Epoxy grout shall be modified as required for each application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be “Sikadur 42, Grout-Pak” by Sika Corporation, or “MasterFlow 648” by Master Builders Solutions.

## 2.02 CURING MATERIALS

A. Curing materials shall be as specified in Section 03 39 00 – Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

# PART 3 – EXECUTION

## 3.01 GENERAL

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete, when approved by the Engineer. Grout toppings swept in by equipment mechanisms shall contain macro-synthetic fibers as specified in Section 03 30 00 – Cast-in-Place Concrete.

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.

B. New concrete surfaces to receive cement grout shall be as specified in Section 03 35 00 – Concrete Finishes, and shall be cleaned of all dirt, grease, and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping, or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03 39 00 – Concrete Curing.

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

## 3.02 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

## 3.03 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

## 3.04 GROUT INSTALLATION

A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be placed from one side only and allowed to flow across to the open side to avoid air-entrapment.

**END OF SECTION**

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## SECTION 04 05 13
## MORTAR AND MASONRY GROUT

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment, and appliances required for complete execution of mortar and masonry grout work shown on Drawings and specified herein.

B. Principal items of work include:

1. Mortar for unit masonry work
2. Grout for grouting masonry
3. Mortar for pointing and touchup

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 – Cast-In-Place Concrete

B. Section 04 05 23 – Masonry Accessories

C. Section 04 20 00 – Unit Masonry

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, the mortar and masonry grout work shall conform to the applicable requirements of the following documents:

1. ASTM C91 – Standard Specification for Masonry Cement
2. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar
3. ASTM C150 – Standard Specification for Portland Cement
4. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes
5. ASTM C270 – Standard Specification for Mortar for Unit Masonry
6. ASTM C404 – Standard Specification for Aggregate for Masonry Grout
7. ASTM C476 – Standard Specification for Grout for Masonry
8. ASTM C979 – Pigments for Integrally Colored Concrete

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9. ASTM C1019 – Standard Methods of Sampling and Testing Grout

10. TMS 602 – Specification for Masonry Structures

## 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's data and mixing instructions for each product

2. Certificate of compliance with this Section for each material specified herein

3. Mix design for masonry grout

4. Test reports

5. Samples of colored masonry mortar

## 1.05 DELIVERY AND STORAGE

A. Deliver materials in manufacturer's original containers, bearing labels indicating product and manufacturer's name.

B. Store cementitious materials in waterproof locations to prevent damage by elements. Reject containers showing evidence of damage.

C. Store aggregates in separate bins to prevent intrusion of foreign particles. Do not use bottom 6 inches of sand or other aggregate stored in contact with the ground.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products manufactured by one of the following:

1. LaFarge, Reston, VA

2. Lehigh Cement Company, Allentown, PA

3. Holcim, Inc., Dundee, MI

## 2.02 MATERIALS

A. Mortar and Grout Materials

1. Materials used in the production of masonry grout shall meet the requirements of Section 03 30 00 – Cast-In-Place Concrete, PART 2 – PRODUCTS, except coarse and fine aggregate shall meet the requirements of ASTM C404.

2. Hydrated lime: ASTM C207, Type "S".

3. Sand: Clean, coarse, free of loam, salt, organic and foreign matter and conforming to ASTM C144.

4. Masonry Cement: ASTM C91, Type S and meet the following criteria:

   a. Prepackaged masonry cement shall contain Portland Cement, hydrated lime and plasticizing admixtures or hydraulic hydrated lime. Masonry cements which contain other materials, including ground limestone, ground slag, or other cementitious and non-cementitious materials, are not acceptable.

5. Water: Clean, fresh, potable, and free from injurious amounts of oil, acids, alkalis, salts, organic matter or other deleterious substances.

B. Admixtures

1. Do not use calcium chloride.

2. Provide water repellant admixture in mortar used for architectural concrete masonry units. Admixture shall be compatible with ACMU water repellant admixture.

3. Do not use admixtures, without written approval of Engineer.

C. Mortar pigment

1. Natural or synthetic iron oxide and chromium oxides meeting the requirements of ASTM C979.

2. Pigment shall not exceed 10% of the weight of Portland cement. Carbon black shall not exceed 2% of Portland cement.

3. Color shall be selected by the Owner from the manufacturer's full range of colors.

## 2.03 GROUT AND MORTAR MIXES

A. Masonry mortar shall be Type "S" according to ASTM C270. Proportions for masonry mortar shall be one of the following:

1. Proportions by volume: 1 part Portland cement to 1/4 to 1/2 parts hydrated lime, and aggregate volume of not less than 2-1/4 or more than 3 times the sum of the volumes of cement and lime.

2. Proportions by volume: 1/2 part Portland cement to 1 part masonry cement, and aggregate volume of not less than 1-1/4 or more than 3 times the sum of the volumes of cement and lime.

B. Proportions for Pointing Mortar

1. Proportions by Volume: 1 part Portland cement to 1/4 part hydrated lime and 2 parts extra fine sand.

C. Masonry Grout shall conform to the requirements of ASTM C476 and ACI 530.1/ASCE 6. Strength of grout, tested in accordance with ASTM C1019, shall be equal to f'm as specified in Section 04 20 00 – Unit Masonry, but not less than 2,000 psi.

1. Owner’s construction materials testing firm will test grout for every 5,000 square feet of masonry, with a minimum of one test per structure.

# PART 3 – EXECUTION

## 3.01 FIELD MORTAR MIXING

A. Mixing shall be by mechanically operated batch mixer. Entirely discharge before recharging. Mix sand, lime, cement and admixtures dry for 2 minutes minimum, add water and mix for 3 minutes minimum. Control batching procedures by measuring materials by volume. Measurement by shovel count shall not be permitted. Mix mortar with less water than the maximum amount, consistent with workability, to provide near maximum tensile bond strength. Mix only quantity that can be used before initial set, or within the first one-half hour.

B. Mixers, wheelbarrows, mortar boards, etc., shall be kept clean.

C. Retempering of mortar will not be permitted and mortar allowed to stand more than 1 hour shall not be used.

## 3.02 INSTALLATION

A. Install mortar and grout in accordance with TMS 602.

### 3.03 REPOINTING MORTAR

A. Prehydrate the mortar by mixing ingredients together dry and then add only enough water to make a damp, stiff mix that will retain its form when pressed into a ball. After one to two hours, add water to bring it to the proper consistency.

**END OF SECTION**

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# SECTION 04 05 23
# MASONRY ACCESSORIES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of masonry accessories work shown on Drawings and specified herein.

B. Principal items of work include:

1. Metal joint reinforcement for masonry

2. Accessories for masonry construction

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04 05 13 – Mortar and Masonry Grout

B. Section 04 20 00 – Unit Masonry

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, masonry accessories work shall conform to the applicable requirements of the following documents:

1. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

2. ASTM A951 – Standard Specification for Steel Wire Masonry Joint Reinforcement

3. ASTM A1064/1064M – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

4. ASTM D1056 – Standard Specification for Flexible Cellular Materials - Sponge or Extruded Rubber

5. TMS 602 – Specifications for Masonry Structures

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's complete product data

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2. Manufacturer's certification attesting compliance of material and source of each material specified herein

## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS FOR MASONRY REINFORCEMENT

A. Subject to compliance with the Specifications, provide products manufactured by the following:

1. AA Wire Products, Company, Chicago, IL

2. Dur-O-Wal, Inc., Arlington Heights, IL

3. Heckmann Building Products, Inc., Chicago, IL

4. Holman and Barnard, Inc., Hauppauge, NY

### 2.02 MATERIALS

A. Multi Wythe Joint Reinforcement

1. Steel ladder type reinforcement conforming to ASTM A951 with adjustable pintel and eye assembly; 3/16-inch side rods and 9-gauge continuous cross rods; manufactured with wire conforming to ASTM A1064/1064M, with widths 2 inches less than nominal wall thickness. Provide seismic clip with 9-gauge continuous wire.

B. Single Wythe Joint Reinforcement

1. Steel ladder type reinforcement conforming to ASTM A951 with 3/16-inch side rods and 9-gauge continuous cross rods; manufactured with wire conforming to ASTM A1064/1064M, with widths 2-inches less than nominal wall thickness.

C. Anchors: Cast into concrete or weld to steel.

1. Dovetail slot shall be 1-inch back by 1-inch deep by 5/8-inch throat, 22-gauge, foam filled.

2. Dovetail Anchor: Accessory for anchoring triangular flexible tie to dovetail slot shall be 12-gauge by 1-inch wide by 1/2-inch long dovetail section.

3. Wire/Strap Anchor: 1/4-inch wire or 12-gauge x 3/4-inch x length required, welded or mechanically attached to back up structure.

D. Ties

1. Triangular Flexible Tie: 3/16-inch wire, sized to suit application.

2. Adjustable Tie: Pintel and eye full tie; properly sized for application, 3/16-inch cold drawn steel.

E. Seismic Clip and Continuous Wire

1. Seismic clip shall be impact resistant PVC with retaining ridges to accept continuous wire.

2. Continuous wire shall be 9-gauge galvanized steel.

F. Top of Wall Anchor

1. Top of wall anchor shall be a 3/8-inch-diameter rod welded to a 3/16-inch plate with two anchor holes. Provide a plastic tube to allow vertical deflection.

G. Finish

1. Reinforcements, anchorages and ties shall be hot dipped galvanized, Class B-2, after fabrication in accordance with ASTM A153.

**2.03 ACCESSORIES**

A. Expansion and Joint Filler Material

1. Closed cell neoprene material conforming to ASTM D1056, with a minimum compressibility of 50%. Horizontal joint filler shall be 1/4 inch thick. Expansion joints shall be a minimum 3/8 inch thick.

B. Control Joint

1. Wide flange rapid preformed neoprene or PVC gasket.

C. Hardware Cloth

1. 1/2-inch hardware cloth.

D. Through Wall Flashing

1. Self-sealing, fully adhering composite flashing consisting of 32-mil rubberized asphalt bonded to an 8-mil cross laminated polyethylene film to produce an overall 40 mil thickness.

2. Provide Perm-A-Barrier Wall Flashing by W.R. Grace, Flash-Bond by Wire-Bond or Poly-Barrier Wall Flashing by Polytite Manufacturing Corporation.

## PART 3 – EXECUTION

### 3.01 REINFORCEMENT AND ANCHORAGE

A. In masonry wall panels, place horizontal joint reinforcement at a vertical spacing of 16 inches on center, unless otherwise noted.

B. Lap side rods at each end joint a minimum of 6 inches.

C. Install prefabricated corner and tee assemblies at each wall corner and intersection.

D. Mitre and butt end joints are prohibited.

E. Place horizontal joint reinforcement in approximate center of out-to-out wall assembly and assuring a 5/8-inch, minimum, mortar coverage on exterior face and 1/2-inch on interior face.

F. Veneer ties and wire anchors shall be length required to provide a minimum of 1-1/2 inch engagement into the veneer and assuring a 5/8-inch, minimum, mortar coverage on exterior face and 1/2-inch on interior face.

G. Adjustable anchor assemblies may be offset no more than that which is stated in manufacturer's published instructions. Pintles may be installed either up or down.

H. Install horizontal joint reinforcement continuous, terminating only at vertical control joints.

I. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend 24 inches minimum each side of opening.

J. Place joint reinforcement continuous and at 8 inches on center vertically above roof.

K. Place reinforcing bars supported and secured against displacement. Maintain position with 1/2 inch to true dimension.

L. Coordinate and verify that dowels and anchorages embedded in concrete and attached to structural steel members are properly placed.

M. Provide wall ties for masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place at maximum 8 inches on center each way around perimeter of openings, within 12 inches of openings.

N. Masonry adjacent to steel and concrete columns to be attached to the column with masonry anchors at 16 inches on center. Anchors to be attached to each face of the column which is adjacent to a masonry wall, unless otherwise noted.

## 3.02 DOVETAIL SLOTS AND ANCHORS

A. Provide dovetail slots to concrete subcontractor for placement into the concrete construction. Dovetail slots shall be placed vertically and spaced 16 inches on center horizontally.

B. Remove slot filler after forms are removed.

C. Hook dovetail anchor into slots and set in masonry joints at 16 inches on center.

## 3.03 BENDING, CUTTING AND SPLICING REINFORCEMENT

A. Make bends and splices in reinforcement only where indicated, or prior approval by Engineer. Bend reinforcement only when cold, and prior to any placement in construction, forming around a steel pin of diameter at least 6 times the reinforcement size. Cut bars only by approved sawing, shearing or welding methods. Make ends of reinforcement straight, square, clean and free of defects before splicing. Do not heat or weld bends and splices at points of maximum stress. Clip and bend any tie wires as required to direct the ends away from external surfaces of masonry walls.

B. Where welding is necessary, provide materials and perform welding in accordance with AWS requirements.

C. All lap splices to be 48 bar diameters, unless otherwise noted.

## 3.04 THROUGH WALL FLASHING

A. Clean areas to receive flashing. Surface shall be free of voids, spalled areas, or sharp protrusions. Concrete surfaces shall be cured a minimum of 7 days.

B. Apply primer as recommended by manufacturer.

C. Apply flashing in strict accordance with manufacturer's instructions and recommendations. Sidelaps shall be a minimum of 2-1/2 inches. End laps shall have a 6-inch minimum lap. Provide end dams at ends of lintels and other interruptions.

D. Seal flashing where vertical reinforcing penetrates flashing with a mastic approved for use by manufacturer.

**END OF SECTION**

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# SECTION 04 20 00
# UNIT MASONRY

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment, and appliances required for complete execution of unit masonry work shown on Drawings and specified work.

1. Principal items of work include:

a. Exterior masonry wall construction.

b. Interior masonry wall construction.

c. Installation of masonry reinforcement and accessories.

d. Masonry unit lintels.

e. Installing insulation, flashing and work required to be built into masonry work.

f. Building into masonry work all anchors, inserts, hangers, and other appurtenances provided under other Sections.

g. Pointing and cleaning of exposed masonry surfaces.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 21 00 – Reinforcing Steel

B. Section 04 05 13 – Mortar and Masonry Grout

C. Section 04 05 23 – Masonry Accessories

D. Section 07 21 00 – Building Insulation

E. Section 07 60 00 – Flashing and Sheet Metal

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, the unit masonry work shall conform to the applicable requirements of the following documents:

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1. TMS 402 – Building Code Requirements for Masonry Structures

2. TMS 602 – Specifications for Masonry Structures

    a. TMS 602 shall be considered minimum specifications for all materials, workmanship, methods, and techniques for all masonry work.

    b. Obtain a copy of the above specifications prior to beginning any work under this Section.

3. ASTM C62 – Standard Specification for Building Brick

4. ASTM C90 – Standard Specification for Load-Bearing Concrete Masonry Units

5. ASTM C140 – Standard Methods for Sampling and Testing Concrete Masonry Units

6. ASTM C216 – Standard Specification for Facing Brick

7. ASTM C744 – Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units

8. ANSI A41.1 R70 – Code Requirements for Masonry

## 1.04 TESTING

A. Tests

1. The Owner reserves the right to test materials for compliance with these specifications. Sampling and testing will be done in accordance with the ASTM standard, by an independent testing agency employed by the Owner. Materials that fail to meet requirements are considered defective. Subsequent tests to establish compliance (of the same or new materials) shall be paid for by the Contractor.

## 1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Samples of each material to be used showing standard range of colors.

2. Manufacturer's specifications and certifications of compliance to the Specifications, including results of tests on masonry units showing such compliance, for each type of masonry. Provide handling, storage, and installation instructions along with protection instructions. Indicate by transmittal that installer has received copies of each instruction.

3. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual (SP66), shall be furnished for all deformed bar reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, locations, spacing and splicing of the bars.

4. Cold and/or hot weather construction procedures in accordance with ACI 530.1/ASCE 6 sections 2.3.2.2. and 2.3.2.3.

5. Cleaning procedures and cleaner for each masonry type.

## 1.06 MOCK-UPS

A. Build mock-ups at the site, where directed, full thickness and approximately 4 feet x 4 feet, indicating the proposed color range, texture, and workmanship for each type of masonry. Obtain Engineer's acceptance of visual qualities of the mock-up before start of masonry work. Do not alter, move, or destroy mock-ups until Work is completed and removal is directed by the Engineer.

## 1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in the manufacturer's original unbroken, undamaged, and unopened packaging with labels bearing the name of the manufacturer and the product. Masonry units and brick shall be factory packaged and strapped, delivered to the site and stored on skids.

B. Store and handle materials to prevent inclusion of water or foreign matter and to prevent damage of any nature.

C. Distribute materials on floor slabs to prevent overloading. Designated live loads shown for floor shall not be exceeded.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. Provide special shape, type or size indicated or for application requiring a form, size or finish which cannot be produced from standard masonry units by sawing. Provide solid units where masonry unit is exposed.

B. Masonry units for fire-rated walls shall comply with UL requirements for fire rating shown on the Drawings.

C. Deformed bar reinforcing steel shall meet the requirements of Section 03 21 00 – Reinforcing Steel.

## 2.02 MATERIALS

A. Mortar

1. In accordance with Section 04 05 13 – Mortar and Masonry Grout

B. Concrete Masonry Units

1. Provide units conforming to ACI 530.1 unless otherwise specified.

2. Provide light weight units meeting the requirements of ASTM C90 for hollow and solid load bearing CMU.

3. Manufacture units of Portland Cement, conforming to ASTM C150 and light weight aggregate conforming to ASTM C331 and ASTM C33. Weight of unit shall not exceed 105 lbs per cu ft when measured in accordance with provisions of ASTM C140. Units shall be nominally 8 inches x 16 inches x thicknesses shown or as required. Masonry units shall be manufactured not less than 30 days prior to being used and stored under cover until shipment. All units shall have true, sharp edges and corners, free from cracks or other defects. Provide half special sizes and shapes as required by the Drawings or to meet job conditions.

4. Net area compressive strength of concrete masonry units shall be a minimum of 2,000 psi when tested in accordance with ASTM C140. Compressive strength of masonry (f'm) shall be a minimum of 2,000 psi in accordance with ACI 530.1 when these units are used with the mortar specified in Section 04 05 13 – Mortar and Masonry Grout.

C. Concrete Masonry Lintels

1. Specially formed units with reinforcing bars and grout fill provided where shown and wherever openings in masonry are indicated without structural steel or other supporting lintels.

D. Architectural Concrete Masonry Units

1. Scored smooth and split-face CMU shall be manufactured by firm producing architectural concrete masonry units for a minimum of 5 years.

2. Units shall conform to ASTM C90, Type I, normal weight.

3. Provide units with integral water repellant admixture. Absorption shall not exceed 10 lbs per cubic foot.

4. Minimum compressive strength shall be 2,700 psi on wet area of a single unit.

5. Color shall be selected from manufacturer standard line of colors. Up to two colors shall be selected.

E. Insulated Block System

1. Pre-Insulated specially formed masonry units with individually molded insulation. Units shaped to reduce cross-web thermal conductance. CMU and Insulation shall be configured to provide a near continuous insulated plane within wall.

a. Provide light weight units conforming to ASTM C90. Weight of unit shall not exceed 105 lbs per cu ft when measured in accordance with provisions of ASTM C140.

b. Individually molded expandable polystyrene, conforming to ASTM C578.

c. Reinforced insulated block system wall thermal resistance shall be R-10, minimum.

d. Use corner units that maintain continuity of the insulation inserts.

e. Exterior finish shall be split faced.

f. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1) Korfil Hi-R Masonry Wall System, by Concrete Block Insulating Systems, West Brookfield, MA

2) Or Approved Equal

## PART 3 – EXECUTION

### 3.01 GENERAL

A. Examine areas and conditions under which masonry is to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

B. Do not wet concrete masonry units.

C. Brick having absorption rates in excess of 0.025 oz per square inch per minute (as determined per ASTM C67) shall be wetted sufficiently so that the rate of absorption, when brick is laid, does not exceed this amount.

D. Clean reinforcing, removing loose rust, ice, or other coatings from bars, before placement.

E. Thickness of cavity and composite walls, and other masonry construction shall be the full thickness shown. Build single wythe walls to the actual size of masonry units.

F. Build chases and recesses as shown and as required for the work of other trades.

G. Build other work into masonry work as shown, fitting masonry units around other work and grouting to assure anchorage.

H. Cut masonry units with motor driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown or specified, and to fit adjoining work neatly.

I. Cold and Hot weather Construction

1. No masonry shall be erected when ambient temperature has dropped below 45°F unless it is rising and at no time when it has dropped below 40°F. Provisions shall be made for heating and drying of materials, and the complete work shall be protected in accordance with the ACI 530.1/ASCE 6, Section 2.3.2.2. Masonry shall not be laid with ice or frost on its surfaces, and no masonry shall be laid on frozen work. Any work which freezes before the mortar has set shall be removed and replaced at the Contractor's own expense. Do not use any admixtures or antifreeze in the mortar.

2. When the temperature is above 100°F or 90°F with a wind velocity greater than 8 mph, mortar beds shall be spread no more than 4 feet ahead of masonry and masonry units shall be set within one minute of spreading mortar.

## 3.02 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.

C. Variation of Linear Building Line: For position shown on plan and related portion of columns, walls, and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.

D. Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".

E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

F. Variation in Vertical Reinforcement for Insulated Block System: Do not exceed ¼"" from the center of the grouted cell where vertical reinforcement is placed.

## 3.03 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half size units at corners, jambs, and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below.

D. Stopping and Resuming Work: Rack back 1/2 unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, and remove loose masonry units and mortar prior to laying fresh mortar.

E. Cover top of walls at the end of each day. Protect wall from water infiltration from the top until wall is capped.

F. Built-In Work: As work progresses, build-in items specified under this and other sections of these Specifications. Fill in solidly with masonry around built-in items.

1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of hardware cloth in the joint below and rod grout into core.

3. Fill cores in hollow masonry units with grout three courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise noted.

4. Seal masonry tight around wall penetrations such as beams, joists, pipes, ducts, and conduit by cutting masonry units to fit as tightly as possible, then closing final gap all around with mortar, or joint filler and caulking as necessary.

## 3.04 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also bed webs with mortar in starting courses on footing or floors, and where adjacent cells are to be reinforced or filled with grout. For starting courses where cells are not grouted, spread full mortar bed including areas under cells.

C. Maintain joint widths of 3/8", except for minor variations required to maintain bond alignment.

D. Tooling: Joints shall be tooled to a uniform concave joint. Head joints first and then the bed joints.

E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners and jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean, and reset in fresh mortar.

## 3.05 JOINT REINFORCING

A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints not more than 16" o.c. vertically.

B. Parapets: Use continuous horizontal joint reinforcement installed in horizontal joints at 8" o.c. vertically.

C. Reinforced masonry openings greater than 12" wide, with horizontal joint reinforcing placed in 2 horizontal joints immediately above the lintel and immediately below the sill. Extend reinforcements 2'-0" beyond jambs of the opening except at control joints.

D. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

E. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.

F. Intersecting Load-Bearing Walls: Provide rigid steel anchors at not more than 2'-0" o.c vertically. Embed ends in mortar-filled cores.

G. Non-Load-Bearing Interior Partitions: Build full height of story to underside of solid floor or structure above, unless shown otherwise. Fill joint with mortar after dead load deflection of structure above approaches final position.

## 3.06 CAVITY WALLS

A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity, flush.

B. Tie exterior wythe to back-up wythe of masonry with horizontal joint reinforcement at 16" o.c. vertically.

C. Coordinate placement of insulation board with work to ensure there are no gaps or air spaces between pieces of insulation board.

D. Weep joints shall be placed in exterior wythe of cavity wall, spaced a maximum of 32" o.c. horizontally, immediately above ledges, at lintels over openings, and as shown.

## 3.07 CAVITY WALL INSULATION

A. Provide and install insulation as shown and as specified in Section 07 21 00 – Building Insulation.

## 3.08 CONTROL AND EXPANSION JOINTS

A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.

## 3.09 LINTELS

A. Install galvanized steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 8" for brick size units and 1'-4" for block size units are shown without structural steel or other supporting lintels. Provide precast or poured-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

C. For hollow concrete masonry unit walls, use specially formed "U"-shaped lintel units with reinforcement bars placed as shown and filled with grout.

D. Provide minimum bearing of 8" at each jamb.

## 3.10 FLASHING

A. Provide flashing as shown and as specified in Section 07 60 00 – Flashing and Sheet Metal.

## 3.11 REINFORCED UNIT MASONRY

A. Vertical reinforcement shall be held in place by means of frames or other suitable means. Place horizontal joint reinforcement as masonry work progresses. Provide

minimum clear distance between longitudinal bars equal to nominal diameter of bar. Minimum thickness of mortar or grout between masonry and reinforcement shall be 1/4", except 6 gage or smaller wires may be laid in 3/8" mortar joints. Collar joints which contain both horizontal and vertical reinforcement shall have a minimum width of 1/2" larger than the diameter of the horizontal and vertical reinforcement.

B. Bar splices shall be contact lap splices. Length of splice shall be as shown on Structural Drawings.

C. Low lift grouting shall be used when grout space is less than 2" in width. Place grout at maximum intervals of 24" in lifts of 6 to 8 inches as the work progresses. Cores to be grouted shall be clean of mortar, mortar dropping and debris. Agitate grout to assure complete filling and coverage of reinforcement. Hold grout 1-1/2 inches below to top of masonry if work is discontinued for more than an hour.

D. High lift grouting may be used when the grout space is greater than 2". Grout shall not be placed in lifts greater than 4 feet. Grout core shall be kept clean of mortar, mortar dripping and debris. Provide cleanout holes as required for inspection and cleaning. Replace cleanout plugs after inspection and acceptance. Place grout in accordance with TMS 402 and TMS 602. Hold grout 1-1/2 inches below top of masonry if work is discontinued for more than an hour.

E. Forms and shoring shall be substantial and tight to prevent leakage of mortar or grout. Brace and shore forms to maintain position and shape. Do not remove forms or shoring until masonry gains enough strength to sufficiently carry its own weight and any other loads, temporary or permanent, placed on it during construction.

## 3.12 PROTECTION OF WORK

A. Exposed masonry surfaces shall be protected from staining. Tops of wall shall be covered with nonstaining waterproof coverings when work is not in progress. Installed material shall be secure in high winds.

B. Protection shall be provided for all openings in the walls to prevent damage to sills, jambs, etc., from all causes. Aluminum or steel frames and other finish materials shall be protected from damage during masonry work.

## 3.13 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing of Masonry: At the completion of the masonry work, all holes in exposed masonry shall be pointed. Defective joints shall be cut out and tuckpointed solidly with

mortar. Pointing and tuckpointing shall be done with a pre-hydrated mortar. The mortar cement shall be controlled so that, after curing of the mortar, no difference in texture or color exists with that of adjacent masonry.

C. Masonry Cleaning: While laying masonry units, good workmanship and job housekeeping practices shall be used to minimize the need for cleaning the masonry work. Protect the base of the wall from mud splashes and mortar droppings. The technique for laying masonry shall be such that mortar does not run down the face of the wall or smear onto the face.

1. After the joints are tooled, cut off mortar failings with the trowel and brush excess mortar burrs and dust from the face of the masonry, use a bricklayer's brush made with medium soft hair.

2. Remove all large mortar particles with a hardwood scraper.

3. If, after using the above outlined techniques, additional cleaning of the walls is found necessary, allow the walls to cure one month prior to initiating further cleaning processes.

D. Clean masonry to comply with the masonry manufacturer's directions and applicable NCMA "Tek" bulletins or BIA technical notes and the following requirements.

1. Saturate the wall with clean water. The wall shall be thoroughly saturated prior to and at the time the cleaning solution is applied.

2. Clean masonry with an approved cleaning solution for each type of masonry applied with a brush, starting at the top of the wall. Approved cleaners shall be composed primarily of detergents, wetting agents, buffering agents, and a maximum of 10% muriatic acid. Do not use acids on masonry surfaces that will be damaged by use of an acid cleaner. The use of any of the above cleaning agents shall first be approved in writing by the manufacturer of the masonry being cleaned and the Engineer. The concentration, method of application of the cleaning solution, and method of scraping shall be as outlined on the container by the manufacturer.

3. High pressure water and sandblasting shall not be used for cleaning except with the recommendation of the masonry manufacturer and the written approval of the Engineer.

4. Immediately after cleaning a small area, the wall shall be rinsed thoroughly with quantities of water.

5. Protect adjacent surfaces and materials during masonry cleaning operations.

6. After the walls are cleaned, take the necessary precautions to ensure that other contractors and subcontractors do not damage or soil the walls. Mud protection around the base of walls shall be left in place until the grading work is done.

**END OF SECTION**

## SECTION 05 05 13
## GALVANIZING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See Section for the specific item in question.

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia State Minimum Standard Building Code

2. ASTM A123 – Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

5. ASTM A780 – Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings

6. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

7. ASTM F2329 – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

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## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

# PART 2 – PRODUCTS

## 2.01 GALVANIC COATING

A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

# PART 3 – EXECUTION

## 3.01 FABRICATED PRODUCTS

A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips 1/8-inch-thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.

B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.

C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer’s facility per ASTM A123.

## 3.02 HARDWARE

A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

## 3.03 ASSEMBLED PRODUCTS

A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.

B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings required in Section 05 12 00 – Structural Steel for approval. All vent and drain holes shall be plugged and finished to be flush with and blend in with the surrounding surface. Where water intrusion can occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

## 3.04 METAL DECK

A. Unless noted otherwise, metal deck shall be galvanized in accordance with ASTM A653, G60 minimum. In moist environments or as indicated on the Contract Drawings, galvanizing shall meet the requirements of ASTM A653, G90.

B. Galvanized metal deck shall meet the requirements of ASTM A924.

## 3.05 REPAIR OF GALVANIZING

A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with two coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the two coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Engineer.

**END OF SECTION**

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## SECTION 05 05 23
## METAL FASTENING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 13 – Galvanizing

B. Section 05 10 00 – Metal Materials

C. Section 05 12 00 – Structural Steel

D. Section 05 13 00 – Stainless Steel

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia State Minimum Standard Building Code
2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
4. ACI 318 – Building Code Requirements for Structural Concrete
5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
7. AISC – RCSC Specification for Structural Joints Using High Strength Bolts
8. AISC – Code of Standard Practice
9. AWS D1.1 – Structural Welding Code – Steel
10. AWS D1.2 – Structural Welding Code – Aluminum

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11. AWS D1.6 – Structural Welding Code – Stainless Steel

12. AA – Specifications for Aluminum Structures

13. ASTM A36 – Standard Specification for Carbon Structural Steel

14. ASTM A489 – Standard Specification for Eyebolts

15. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts

16. ASTM A572/A572M – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe

18. ASTM E3121 – Standard Test Methods for Field Testing of Anchors in Concrete or Masonry

19. ASTM F436 – Standard Specification for Hardened Steel Washers

20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use

21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs

22. ASTM F594 – Standard Specification for Stainless Steel Nuts

23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.

2. Anchor design calculations sealed by a Professional Engineer currently registered in the state of Alabama. Only required if design not shown on Contract Drawings.

3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.

4. Manufacturer’s installation instructions.

5. Copy of valid certification for each person who is to perform field welding.

6. Certified weld inspection reports, when required.

7. Welding procedures.

8. Installer qualifications.

9. Certification of Installer Training.

10. Inspection Reports.

11. Results of Anchor Proof Testing.

12. Manufacturer's Literature for Resistance of Adhesive to Appropriate Chemical Exposure, where deemed necessary.

## 1.05 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (mechanical anchors) or 355.4 (adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).

C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installers for anchor installations shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

D. Installer Training: For concrete anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.

6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

G. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

I. Special inspections for concrete adhesive anchors shall be conducted in accordance with the manufacturer's instructions and Section 01 45 33 – Special Inspections. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

## PART 2 – PRODUCTS

### 2.01 ANCHOR RODS

A. Anchor rods shall conform to ASTM F1554, Grade 55 except where stainless steel or other approved anchor rods are shown on the Drawings or stated herein. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563, Grade A. Plate washers shall meet the requirements of ASTM A572, Grade 50.

B. All anchor rods into concrete shall be cast-in-place anchors unless specifically referenced otherwise on Drawings.

C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot dipped galvanized in accordance with ASTM F1554.

D. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

## 2.02 HIGH STRENGTH BOLTS

A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125, Grade A325 Type 1 or Grade F1852 Type 1. Bolts, nuts, and washers shall meet the requirements of RCSC Specification for Structural Joints Using High Strength Bolts.

B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM A325.

## 2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F593 for alloy groups 1 and 2, Condition CW1, or ASTM F3125. All fasteners for aluminum and stainless steel members that are underwater, in confined areas containing fluid, and in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the previously listed conditions shall be Type 304 stainless steel unless otherwise noted.

B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts, washers, and lock washers shall be of the same alloy as the bolts.

## 2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed as follows shall be used. Where one of the types listed as follows is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed as follows shall be based on test data performed by an approved independent testing laboratory. Two types of anchors shall be used:

    a. Mechanical anchors include any of the following anchors:

        1) Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.

2) Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one-piece, heavy duty screw anchors with a finished head.

b. Adhesive anchors shall consist of threaded rods anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two-part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to the International Building Code and ACI 318 Appendix D requirements as applicable, including seismic test requirements.

3. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire-resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or be only as anchors for non-structural elements.

4. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Wedge Anchors

a. Do not use when subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Suitable for use in overhead applications.

C. Screw Anchors

a. Do not use when subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Suitable for use in overhead applications.

D. Sleeve Anchors

a. Do not use when subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Suitable for use in overhead applications.

E. Undercut Anchors

a. Suitable for use where subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Suitable for use in overhead applications.

F. Adhesive Anchors in Concrete

a. Suitable for use where subjected to vibration.

b. Suitable for use in exterior locations or locations subjected to freezing.

c. Suitable for use in submerged, intermittently submerged, or buried locations.

d. Do not use in overhead applications, unless otherwise shown or approved by Engineer.

e. Suitable for use in chemical areas provided manufacturer's literature confirms appropriate chemical resistance.

f. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

G. Adhesive Anchors in Masonry (where cells have been fully grouted)

a. Suitable for use where subjected to vibration.

b. Suitable for use in exterior locations or locations subjected to freezing.

c. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

d. Suitable for use in precast hollow core planks provided cores have been fully grouted.

H. Concrete Anchor Design

1. Basis of design shall include the following design parameters:

   a. Actual compressive strength of concrete.

   b. Cracked concrete conditions.

   c. Dry or water saturated installation conditions.

   d. Base material temperature between 40- and 104-degrees Fahrenheit.

   e. Installation with hammer drill or hollow-drill bit system drilling methods.

   f. Installation not prior to 21-day minimum age of concrete.

2. An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, the anchors shall be installed to the prescribed size, spacing, embedment depth, and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the Contractor shall provide the embedment depth as indicated in Paragraph B, Item 3 unless otherwise directed by the Engineer. Where an anchor design is not indicated on the Drawings, the Contractor shall provide the anchor design per the requirements listed as follows.

   a. The Contractor shall submit design with sealed calculations and drawings performed by a Professional Engineer currently registered in the state of Georgia. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.

   b. Embedment Depth

      1) Minimum anchor embedment shall be as indicated on the Drawings unless anchor design is stipulated to be by Contractor or equipment provider. The provider of equipment including pumps, blowers, etc. shall provide anchor design including size of anchors, pattern, and embedment depth. If the equipment provider is unable to provide design of embedment depth, the design shall be provided by the Contractor using the loads furnished by the equipment provider. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on ““Pure 110+ by DeWalt” ESR 3298 issued 7/2017. If the Contractor submits one of the other concrete adhesive anchors listed, the Engineer will evaluate the required embedment and the Contractor shall provide the required

embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2) Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).

3) The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long-term temperature of 110 degrees F, and maximum short-term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

I. Anchors

1. Mechanical Anchors

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ2" by Hilti, Inc., "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Power-Stud+SD1" or "Power-Stud+ SD-2" by DeWalt.

b. Screw Anchors: Screw anchors shall be "KWIK HUS-EZ", "KWIK HUS-EZ-I", or "KWIK HUS-EZ CRC" by Hilti, Inc., "Titen HD" or "Stainless Steel Titen HD" by Simpson Strong-Tie Co., or "Screw-Bolt+" by DeWalt.

c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by DeWalt.

d. Shallow Embedment Internally Threaded Insert (3/4" max embedment): "Mini-Undercut +Anchor" by DeWalt, "HDI-P-TZ" by Hilti, Inc. or approved equal.

e. Concrete Undercut Anchors: Concrete undercut anchors shall be "HDA Undercut Anchors" by Hilti, Inc, "DUC Ductile Undercut Anchor", by USP Structural Connectors, or approved equal.

f. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193 and shall have a valid evaluation report in accordance with the applicable building code.

2. Adhesive Anchors

a. Adhesive anchors shall be “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET-3G Epoxy Adhesive Anchors” by Simpson Strong-Tie Co., or “Pure 110+ Epoxy Adhesive Anchor System” by DeWalt.

b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308 and shall have a valid evaluation report in accordance with the applicable building code. No or equal products will be considered unless approved by the Engineer and Owner.

J. Concrete Anchor Materials

1. Concrete anchors used to anchor structural steel shall be threaded steel rod conforming to ASTM F1554, Grade 55, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the previously listed conditions shall be Type 304 stainless steel unless otherwise noted.

3. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

## 2.05 MASONRY ANCHORS

A. Adhesive anchors for fastening to solid or grout-filled masonry shall be anchors consisting of threaded rods anchored with an adhesive system. The adhesive system shall be “HIT HY-270 System” as manufactured by Hilti, Inc., “AC100+ Acrylic Adhesive” by DeWalt, or “SET-3G” as manufactured by Simpson Strong-Tie Co.

B. Adhesive anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust prior to installation of adhesive and anchor. Contractor shall follow manufacturer’s installation instructions. The adhesive system shall be “HIT HY-270 System” as manufactured by Hilti, Inc., “AC100+ Acrylic Adhesive” by DeWalt, or “SET-3G” as manufactured by Simpson Strong-Tie Co.

C. Masonry anchors used to anchor steel shall be threaded steel rod conforming to ASTM F1554, Grade 55, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the previously listed conditions shall be Type 304 stainless steel unless otherwise noted.

E. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

F. Although all manufacturers listed are permitted, the masonry anchor design is based on “SET-3G by Simpson Strong-Tie ESR 4844 Revised 10-2023. If the Contractor submits one of the other concrete adhesive anchors listed, the Engineer will evaluate the proposed product and the Contractor shall provide the conditions stipulated by the Engineer specific to the approved adhesive anchor.

G. If the masonry cells are fully grouted and the application is not an exterior application where freezing is a concern, a submerged or below grade application, or an application where vibrations could occur, screw anchors may be considered for anchoring items to masonry walls.

## 2.06 WELDS

A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).

B. Electrodes for welding aluminum shall comply with the AA Specifications and AWS D1.2.

C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

## 2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

## 2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

## 2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C276. Hastelloy fasteners shall be used for fasteners located in chemical areas containing Hydrochloric Acid (Muriatic Acid), Hydrofluosilicic Acid (Fluoride), or Sulfuric Acid.

## 2.10 TITANIUM FASTENERS

A. Titanium fasteners, washers, and nuts shall conform to ASTM B348, Grade 2. Titanium fasteners shall be used for fasteners located in chemical areas containing Ferric Chloride or Sodium Hypochlorite.

## 2.11 ANTISEIZE LUBRICANT

A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

# PART 3 – EXECUTION

## 3.01 MEASUREMENTS

A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

## 3.02 FASTENER INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by securing rods where concrete will be placed and positioned by means of a rigidly secured template. Overhead anchors, and base plates or elements being anchored, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.

3. Post-installed concrete anchors shall not be used in place of cast-in-place anchor rods without Engineer's approval.

4. All stainless steel threads shall be coated with anti-seize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with RCSC “Specification for Structural Joints Using High Strength Bolts”. All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Stainless Steel Bolts

1. Where connections indicate the use of stainless steel bolts, the bolts shall be installed to the snug tight condition. Connections shall include stainless steel washers under both the bolt head and the nut head. Lock washers shall be utilized for all connections and shall be placed under the nut head.

D. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2,500 psi, and ambient temperature at time of installation shall be at least 50 degrees F.

2. Concrete Anchor Testing:

a. At all locations, at least 10 percent of all concrete anchors installed shall be proof tested to 80% of the yield strength of the anchor rod, with a minimum of one tested anchor per anchor group.

b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E3121 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

c. Where Contract Documents indicate anchor design to be the Contractor’s responsibility, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the state of Georgia. Documentation shall also be submitted indicating the Contractor’s proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E3121.

d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting

damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.

3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed, cored holes shall be roughened in accordance with manufacturer requirements. If hammer drills are used to drill holes in slabs, the drills shall be equipped with a depth stop device. The depth of hole shall be the minimum depth required for anchor embedment and development of required capacity. Prior to drilling, the Contractor shall use GPR or other means to confirm anchor installation will not interfere with reinforcement or embedded items, especially electrical conduit. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer's recommendations. Installation conditions shall be either dry or water saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

5. All adhesive anchor installations shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 D.9.2.2. Current AAI Certificate must be submitted to the Engineer of Record prior to commencement of any adhesive anchor installations.

E. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be isolated via an approved dielectric.

2. All stainless steel bolts shall be coated with anti-seize lubricant.

## 3.03 WELDING

A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

C. Welds shown on the Drawings with a field weld symbol shall be field welded. All other welds shall be shop welded unless specifically approved by the Engineer.

## 3.04 INSPECTION

A. High strength bolting will be visually inspected in accordance with RCSC Specification for Structural Joints Using High Strength Bolts. Rejected bolts shall be either replaced or retightened as required.

B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

## 3.05 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into concrete during installation of post-installed anchors without prior approval of the Engineer.

**END OF SECTION**

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## SECTION 05 10 00
## METAL MATERIALS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Metal materials not otherwise specified shall conform to the requirements of this Section.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Materials for fasteners are included in Section 05 05 23 – Metal Fastening.

B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM A36 – Standard Specification for Structural Steel

B. ASTM A47 – Standard Specification for Malleable Iron Castings

C. ASTM A48 – Standard Specification for Gray Iron Castings

D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality

I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

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K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

L. ASTM A536 – Standard Specification for Ductile Iron Castings

M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

O. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

P. ASTM A992 – Standard Specification for Structural Steel Shapes

Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings

S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings

T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings

U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes

V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate

W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod

Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

## 1.04 SUBMITTALS

A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

## 1.05 QUALITY ASSURANCE

A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials, the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

# PART 2 – PRODUCTS

## 2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed as follows:

| | |
|---|---|
| Steel W, C, and MC Shapes | ASTM A992 Grade 50 |
| Steel HP, M, S and L Shapes | ASTM A572 Grade 50 |
| Steel Bars and Plates | ASTM A36 |
| Rods | ASTM F1554 Grade 55 |
| Pipe - Structural Use | ASTM A53 Grade B |
| Hollow Structural Sections | ASTM A500 Grade C or A1085 Grade A |
| Cold-Formed Steel Framing | ASTM A653 |

## 2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed as follows:

| | |
|---|---|
| Plates and Sheets | ASTM A167 or A666 Grade A |
| Structural Shapes | ASTM A276 |
| Fasteners (Bolts, etc.) | ASTM F593 |

## 2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed as follows:

| | |
|---|---|
| Structural Shapes | ASTM B308 |
| Castings | ASTM B26, B85, or B108 |
| Extruded Bars | ASTM B221 - Alloy 6061 |
| Extruded Rods, Shapes and Tubes | ASTM B221 - Alloy 6063 |
| Plates | ASTM B209 - Alloy 6061 |
| Sheets | ASTM B221 - Alloy 3003 |

C. All aluminum shall be provided with mill finish unless otherwise noted.

D. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

## 2.04 CAST IRON

A. Material types and ASTM designations are listed as follows:

| | |
|---|---|
| Gray | ASTM A48 Class 30B |
| Malleable | ASTM A47 |
| Ductile | ASTM A536 Grade 60-40-18 |

## 2.05 BRONZE

A. Material types and ASTM designations are listed below:

| | |
|---|---|
| Rods, Bars and Sheets | ASTM B138 - Alloy B Soft |

## 2.06 HASTELLOY

A. All Hastelloy shall be Alloy C276.

## 2.07 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

| | Zinc | Galvanized Steel | Aluminum | Cast Iron | Ductile Iron | Mild Steel/ Carbon Steel | Copper | Brass | Stainless Steel |
|---|---|---|---|---|---|---|---|---|---|
| **Zinc** | | | ● | ● | ● | ● | ● | ● | ● |
| **Galvanized Steel** | | | ● | ● | ● | ● | ● | ● | ● |
| **Aluminum** | ● | ● | | ● | ● | ● | ● | ● | ● |
| **Cast Iron** | ● | ● | ● | | | | ● | ● | ● |
| **Ductile Iron** | ● | ● | ● | | | | ● | ● | ● |
| **Mild Steel/ Carbon Steel** | ● | ● | ● | | | | ● | ● | ● |
| **Copper** | ● | ● | ● | ● | ● | ● | | | ● |
| **Brass** | ● | ● | ● | ● | ● | ● | | | ● |
| **Stainless Steel** | ● | ● | ● | ● | ● | ● | ● | ● | |

1. "●" signifies dielectric isolation is required between the two materials noted.
2. Consult Engineer for items not listed in table.

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

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# SECTION 05 12 00
# STRUCTURAL STEEL

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC Code of Standard Practice.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 13 – Galvanizing

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Georgia State Minimum Standard Building Code
2. AISC Code of Standard Practice
3. AISC Specification for Structural Steel Buildings
4. AISC – RCSC Specification for Structural Joints Using High Strength Bolts
5. AWS – Structural Welding Code
6. ASTM A786 – Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Certified Mill Test Reports
2. Affidavit of Compliance with grade specified

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3. Shop Drawings which include the following:

    a. Layout drawings indicating all structural shapes, sizes, and dimensions.

    b. Beam and column schedules.

    c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

## 1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at the Owner's expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from the responsibility for furnishing proper materials or workmanship under this Specification.

B. The structural steel erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector.

C. The structural steel fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Building Fabricator.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. Structural Steel

1. Structural steel for W, C, and MC shapes shall conform to ASTM A992 unless otherwise indicated.

2. Structural steel for HP, M, S, and L shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.

3. Structural steel bars and plates shall conform to ASTM A36 unless otherwise indicated.

4. Structural pipe shall be ASTM A53, Grade B.

5. HSS shall be ASTM A500, Grade C or ASTM A1085, Grade A. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.

6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.

7. Fasteners for structural steel shall be in accordance with Section 05 05 23 – Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05 05 23 – Metal Fastening.

## PART 3 – EXECUTION

### 3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

### 3.02 FABRICATION

A. Fabrication shall be in accordance with the AISC Specification for Structural Steel Buildings and AISC Code of Standard Practice. Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods, vent and drain holes or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

E. Where galvanizing of structural steel is required, galvanizing shall be done in accordance with Section 05 05 13 – Galvanizing.

F. Checkered floor plate shall meet the requirements of ASTM A786.

## 3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

## 3.04 ERECTION

A. The erection of all structural steel shall conform to the applicable requirements of the AISC Specification for Structural Steel Buildings and AISC Code of Standard Practice. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened.

C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23 – Metal Fastening.

F. All bolted connections shall use high strength bolts in accordance with Section 05 05 23 – Metal Fastening. High strength bolts shall be installed in accordance with RCSC Specification for Structural Joints Using High Strength Bolts. Bolts specified or noted on the Drawings to be a tension or slip critical “SC” type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 60 00 – Grout.

4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

## 3.05 PAINTING

A. Painting shall be performed according to Section 09 90 00 – Painting and the following additional requirements.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.

2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.

3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

**END OF SECTION**

# SECTION 05 13 00
# STAINLESS STEEL

## PART 1 – GENERAL

### 1.01 SECTION INCLUDES

A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Drawings and specified herein.

B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Section 05 50 00 – Metal Fabrications

### 1.03 REFERENCES

A. ASTM A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

B. ASTM A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

C. ASTM A262 – Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel

D. ASTM A276 – Stainless and Heat-Resisting Steel Bars and Shapes

E. ASTM A314 – Stainless and Heat-Resisting Steel Billets and Bars for Forging

F. ASTM A380 – Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems

G. ASTM A473 – Stainless and Heat-Resisting Steel Forgings

H. ASTM A666 – Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar

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I. ASTM A774 – Stainless Steel Pipe Fittings

J. ASTM A778 – Stainless Steel Pipe

K. ASTM A967 – Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts

L. ASTM F593 – Stainless Steel Bolts, Hex Cap Screws and Studs

M. ASTM F594 – Stainless Steel Nuts

N. ANSI/ASME B1.1 – Unified Inch Screw Thread (UN and UNR Thread Form)

## 1.04 TESTS

A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.

B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:

1. One sample per heat treatment lot for plates and forgings

2. One sample per each Welding Procedure Qualification regardless of the joint design

3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.

4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

## 1.05 SUBMITTALS

A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01 33 00 – Submittal Procedures.

B. Submittals shall include, but not be limited to, the following:

1. Certified test reports for susceptibility to intergranular attack.

2. Affidavit of compliance with type of stainless steel shown on the Drawings or specified herein.

3. Certified weld inspection reports.

4. Cleaning and handling of stainless steel in accordance with Article 3.04 CLEANING AND HANDLING.

C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

## 1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Drawings or the Specifications.

C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from the responsibility for furnishing proper materials or workmanship.

## 1.07 HANDLING, STORAGE AND DELIVERY

A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically passivated surface.

B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.

C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.

D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.

E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.

F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.

G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

## 1.08 FIELD MEASUREMENTS

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

# PART 2 – PRODUCTS

## 2.01 MATERIALS AND FINISHES

A. Stainless steel shall be Type 304 unless noted otherwise herein or on the Drawings. Stainless steel for underwater service, in confined areas containing fluid, or in corrosive environments shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Drawings.

B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.

C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.

D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:

1. No. 1 Strip Finish

    a. No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.

2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.

3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

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**Table 1: Classification of Stainless Steel Product Form**

| Item | Description | Dimensions | | |
|---|---|---|---|---|
| | | Thickness | Width | Diameter or Size |
| Sheet | Coils and cut length: | | | |
| | Mill finishes Nos. 1, 2D and 2B | under 3/16" | 24" and over all widths | - |
| | Polished finishes Nos. 3, 4, 6, 7 & 8 | | | |
| Strip | Cold finished, coils or cut lengths: | | | |
| | Polished finishes Nos. 3, 4, 6,7 & 8 | under 3/16" | under 24" all widths | - |
| Plate | Flat rolled or forged | 3/16" and over | over 10" | - |
| Bar | Hot finished rounds, squares, octagons and hexagons | - | - | 1/4" and over |
| | Hot finished flats | 1/8" to 8" incl. | 1/4" to 10" incl. | - |
| | Cold finished rounds, squares, octagons and hexagons | - | - | over 1/8" |
| | Cold finished flats | 1/8" to 4-1/2" | 3/8" to 4-1/2" | - |
| Wire | Cold finishes only: (in coil) | | | |
| | Round, square, octagon, hexagon and flat wire | under 3/16" | under 3/8" | - |
| Pipe & Tubing | Several different classifications, with differing specifications, are available. | | | |
| Extrusion | Not considered “standard” shapes. Currently limited in size to approximately 6-1/2" diameter or structurals. | | | |

**Table 2: Standard Mechanical Sheet Finishes**

| Unpolished or Rolled Finishes | | Polished Finishes | |
|---|---|---|---|
| **No. 1** | A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling. | **No. 3** | An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication |
| **No. 2D** | A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern. | **No. 4** | A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection. |
| **No. 2B** | A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing. | **No. 6** | A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes. |
| | | **No. 7** | A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes. |
| | | **No. 8** | The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors. |

**Table 3: Conditions and Finishes for Bar**

| Conditions | Surface Finishes[1] |
|---|---|
| Hot worked only | (a) Scale not removed (excluding spot conditioning)<br>(b) Rough turned[2]<br>(c) Pickled or blast cleaned and pickled. |
| Annealed or otherwise heat treated | (a) Scale not removed (excluding spot conditioning)<br>(b) Rough turned<br>(c) Pickled or blast cleaned and pickled<br>(d) Cold drawn or cold rolled<br>(e) Centerless ground<br>(f) Polished |
| Annealed and cold worked to high tensile strength[3] | (a) Cold drawn or cold rolled<br>(b) Centerless ground<br>(c) Polished |

**Table 4: Conditions and Finishes for Plate**

| Condition and Finish | Description and Remarks |
|---|---|
| Hot rolled | Scale not removed. Not heat treated. Plates not recommended for final use in this condition.[4] |
| Hot rolled, annealed or heat treated | Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance.[1] |
| Hot rolled, annealed or heat treated, blast cleaned or pickled | Condition and finish commonly preferred for corrosion resisting and most heat resisting applications. |
| Hot rolled, annealed, descaled and temper passed | Smoother finish for specialized applications. |
| Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed | Smooth finish with greater freedom from surface imperfection than the above. |
| Hot rolled, annealed or heat treated, surface cleaned and polished | Polished finishes refer to Table 2. |

[1] Surface finishes (b), (e) and (f) are applicable to round bars only.

[2] Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

[3] Produced in Types 302, 303Se, 304 and 316.

[4] Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.

B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.

C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.

D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

### 3.02 WELDING

A. Welding shall be done in a manner that will prevent buckling and in accordance with Section 05 05 23 – Metal Fastening, and as modified hereinafter.

B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.

C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to ensure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.

D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:

1. Use lower weld current setting.

2. Use skip-weld techniques to minimize heat concentration.

3. Use back-up chill bars or other cooling techniques to dissipate heat.

E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

## 3.03 FASTENERS

A. Stainless steel fasteners shall be used for joining stainless steel work.

B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

## 3.04 CLEANING AND HANDLING

A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Chemical passivation in accordance with ASTM A967 is required for all stainless steel in contact with process water. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.

B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.

1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.

2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.

C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirts, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.

D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.

1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.

2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon

carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

## 3.05 INSTALLATION

A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.

B. All inserts, anchor rods and all other miscellaneous work specified in the Specifications or shown on the Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.

C. All stainless steel fabrications shall be installed in conformance with details shown on the Drawings or on the approved shop drawings.

**END OF SECTION**

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# SECTION 05 21 00
# STEEL JOISTS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor and services for the delivery, handling, storing and erecting of steel joists in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 12 00 – Structural Steel

B. Section 05 31 00 – Metal Decking

C. Section 05 50 00 – Metal Fabrications

### 1.03 REFERENCE STANDARDS

A. AISC – Specifications for Open Web Steel Joist

B. AWS – Structural Welding Code

C. SJI – Standard Specification, Load Tables and Weight Tables for Steel Joist and Joist Girders,

D. ASTM – Standard Specifications for Materials

E. AISI – Specifications for the Design of Cold-Formed Steel Structural Members.

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Certified mill test reports.

2. Affidavit of compliance with type of grade specified.

3. Joist placement plans showing detailed layouts, design details, connection details, fabrication details, bridging (size, location and connections), deflection criteria and load data.

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4. Signed and sealed calculations from the joist manufacturer's registered professional engineer. Manufacturer's Professional Engineer shall be registered in the state of Georgia.

5. Certified weld inspection reports.

6. Joist manufacturer, at the completion of manufacture, shall provide a certificate of compliance stating that the supplied joists and associated work have been provided in accordance with the approved Contract Documents and with SJI standard specifications.

## 1.05 QUALITY ASSURANCE

A. All materials, workmanship and production methods shall be in accordance with standards in the industry.

B. Joist manufacturers shall submit a certificate of compliance stating that plant and production methods have met the requirements of all joist specifications, codes and standards.

## 1.06 QUALIFICATIONS

A. Steel joist manufacturer must be a member of SJI and conform to SJI standards.

B. Manufacturer must specialize in steel joist design and fabrication for a minimum of 5 years' documented experience.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. Joists and joist girders shall conform to SJI Standard Specifications.

B. Joist location, spacing and loading shall be as shown on the Contract Documents.

C. Joist sizes shown on the Contract Documents must be evaluated by the manufacturer.

# PART 3 – EXECUTION

## 3.01 FABRICATION AND DESIGN

A. Joists shall be designed in accordance with SJI standard specifications as simply supported trusses, unless indicated otherwise on the Drawings.

B. All welding shall conform to AWS Standards. No fusion welding is permitted for steel joists.

C. The number of rows of bridging and type of bridging shall be established by the manufacturer for loads shown on the Drawings.

D. Each joist shall be marked and labeled for identification. All joists shall have one coat of primer shop paint.

## 3.02 DELIVERY AND STORAGE

A. Handle, transport and store joists in a manner to prevent damage affecting their structural integrity. Store all items off the ground in a well-drained location protected from the weather and easily accessible for inspection and handling.

B. Any damaged joists shall not be accepted.

## 3.03 INSTALLATION

A. All bridging and bridging anchors shall be completely installed before roof or floor construction loads are placed on the joists. The ends of all bridging shall be anchored.

B. End anchorage of steel joists shall have a steel bearing plate resting on masonry or concrete, as shown on the Drawings. End anchorage of steel joist resting on steel supports shall be attached with a minimum of two 1/8-inch fillet welds, one inch long, or with 1/2-inch bolts, unless indicated otherwise on the Drawings.

C. The deflection of steel joists due to live load shall not exceed L/360 of span for floors and L/240 of span for roof.

## 3.04 PAINTING

A. Painting shall conform to Section 09 90 00 – Painting.

**END OF SECTION**

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# SECTION 05 31 00
# METAL DECKING

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all labor, equipment, materials and services to install all metal deck complete with all accessories for a complete installation in accordance with the Drawings and as specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 13 – Galvanizing

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Section 05 12 00 – Structural Steel

E. Section 05 21 00 – Steel Joists

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. AISI – Specification for the Design of Cold-Formed Steel Structural Members

B. SDI – Design Manual for Floor Decks and Roof Decks and Manual of Construction with Steel Deck

C. ASTM Standards for Test Methods

D. AWS D1.3 – Structural Welding Code – Sheet Steel

E. ANSI/SDI SD-2022 – Standard for Steel Deck

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete layout and installation drawings and schedules with clearly marked dimensions.

2. Detail and location drawings for all framing, supports, type and location of all welds and fasteners.

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3. Details of all accessories showing welding washers, studs and reinforcing strips.

4. Manufacturer's design calculations or published literature for the structural properties of the metal decking.

5. Qualifications of welders.

## 1.05 QUALITY ASSURANCE

A. All materials, workmanship and production methods shall be in accordance with ANSI/SDI SD-2022 Standard for Steel Deck.

B. Manufacturer shall be regularly engaged in the manufacture of metal decking.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. Steel sheet shall be flat rolled carbon steel sheets meeting the requirements of ASTM A653 Grade 80 for galvanized metal deck or ASTM A1008 Grade 80 for bare metal deck.

B. Minimum yield strength shall be 50 ksi.

C. Unless noted otherwise, metal deck shall be galvanized in accordance with Section 05 05 13 – Galvanizing.

D. Mechanical fasteners used for sidelap connections shall be SDI standard.

# PART 3 – EXECUTION

## 3.01 FABRICATION AND DESIGN

A. Design, fabrication and erection of decking shall comply with references listed in Section 1.03 and manufacturer's recommendations.

B. Deck units shall conform to the SDI standard type and gage shown on the Drawings.

## 3.02 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered in unbroken, undamaged, original packages bearing manufacturer's labels.

B. Metal decking shall be stored off the ground with one end elevated for drainage and covered with vented water-proof material in accordance with decking manufacturer's recommendations.

C. Decking shall be handled so as to preclude damage from any source.

D. Metal decking units may not be used for any purpose (such as scaffold decking) prior to incorporation in the work. Any units which have been so used will be rejected.

## 3.03 INSPECTION

A. Verify correct layout and alignment of supporting members and clean all support surfaces of debris. All defects shall be corrected prior to installation of metal decking.

## 3.04 INSTALLATION

A. Install deck units and accessories in accordance with shop drawings and manufacturer's recommendations. Deck units shall be installed where called for on the Drawings.

B. Position deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end to end before being permanently fastened. Extend deck units over three or more supports unless shown otherwise on the Drawings. Lap ends not less than 2 inches. Place deck units flat and square, secured to adjacent framing without warp or deflection.

C. Secure deck units to supporting members as shown on the Drawings. Weld pattern shall be as indicated on the Drawings in accordance with SDI and AWS D1.3. The Contractor may use an equivalent pattern of mechanical fasteners in lieu of welded fastening.

D. Attach deck at sidelaps with screws as indicated on the Drawings or as recommended by the manufacturer.

E. Cut and fit deck units around openings. Deck manufacturer shall approve openings larger than 6-inch-diameter prior to cutting.

## 3.05 REPAIR OF GALVANIZING

A. Galvanizing shall be repaired at all welds, scarred areas, and rust spots in accordance with Section 05 05 13 – Galvanizing.

## 3.06 CONSTRUCTION GUIDELINES

A. Do not use deck units as a working platform or storage area until units are permanently attached in position.

B. Construction loads shall not exceed the load carrying capacity of the deck.

C. All units damaged during construction shall be repaired or replaced by the Contractor.

**END OF SECTION**

# SECTION 05 50 00
# METAL FABRICATIONS

## PART 1 – GENERAL

### 1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.

B. Work shall include but may not be limited to lintels, guard posts, hoppers, and chutes.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 13 – Galvanizing

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia State Minimum Standard Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specifications for the Design of Cold-Formed Steel Structural Members

4. AA Specifications for Aluminum Structures

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all metalwork specified herein.

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2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

## PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used in metal fabrications shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

### 2.02 METAL FASTENING

A. All welds and fasteners used in metal fabrication shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

### 2.03 LINTELS

A. Provide lintels as shown on the Drawings and specified herein with 8 inches minimum bearing each side unless noted otherwise.

B. All lintels shall be steel in accordance with Section 05 12 00 – Structural Steel and shall be galvanized in accordance with Section 05 05 13 – Galvanizing, unless noted otherwise.

### 2.04 GUARD POSTS (BOLLARDS)

A. Guard posts shall be 6-inch-diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.

B. Guard posts shall be concrete filled and crowned, as detailed on the Drawings.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in Section 09 90 00 – Painting.

## 3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal work shall be field painted when as specified in accordance with Section 09 90 00 – Painting.

**END OF SECTION**

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# SECTION 05 51 00
# METAL STAIRS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 13 – Galvanizing

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Section 05 12 00 – Structural Steel

E. Section 05 52 00 – Guards and Railings

F. Section 05 53 00 – Gratings, Checkered Floor Plates, and Access Doors

G. Section 05 55 00 – Stair Treads and Nosings

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia State Minimum Standard Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specification for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

### 1.04 SUBMITTALS

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A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all metal work specified herein

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening

3. Structural calculations and detailed erection drawings for steel pan stairs. Calculations and drawings shall be signed and sealed by a Professional Engineer currently registered in the state of Georgia.

## PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used for metal stairs shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

### 2.02 METAL FASTENING

A. All welds and fasteners used in metal stairs shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

### 2.03 METAL STAIRS AND LANDINGS

A. Stair stringers and structural framing of landings shall be fabricated from steel or aluminum as indicated on the Drawings.

1. Steel stairs shall be fabricated from steel in accordance with Section 05 12 00 – Structural Steel.

2. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6.

B. Regardless of material of stringers, all stair treads shall be aluminum in accordance with Section 05 55 00 – Stair Treads and Nosings.

C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to Section 05 53 00 – Gratings, Checkered Floor Plates, and Access Doors.

D. Guards for metal stairs shall conform to Section 05 52 00 – Guards and Railings. Contractor shall coordinate attachment of guards to metal stairs.

E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.

F. Closure plates shall be provided for all exposed ends of stringers.

G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.

H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

### 3.02 INSTALLATION

A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal stairs shall field painted when specified in accordance with Section 09 90 00 – Painting.

**END OF SECTION**

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# SECTION 05 51 33
# LADDERS

## PART 1 – GENERAL

### 1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 23 – Metal Fastening

B. Section 05 10 00 – Metal Materials

C. Section 09 90 00 – Painting

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents:

1. Georgia State Minimum Standard Building Code

2. AA Specifications for Aluminum Structures

3. OSHA Regulations

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

## PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used for ladders shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

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## 2.02 METAL FASTENING

A. All welds and fasteners used for ladders shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

## 2.03 LADDERS

A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.

B. Unless noted otherwise on the Drawings, all ladders shall be aluminum alloy 6061-T6 or 6063-T5, with a clear, anodized finish, AA M12C22A41.

C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.

D. Side rails shall be 1-1/2-inch-diameter Schedule 80 pipe, minimum.

E. Rungs shall be serrated 3/4-inch-diameter, minimum.

F. All exposed connections shall be welded and ground smooth.

G. Ladders shall be as manufactured by Thompson Fabricating Company, or equal.

## 2.04 LADDER SAFETY SYSTEM

A. All ladders, regardless of height, shall be installed with a ladder safety system.

B. Ladder safety system shall comply with all OSHA requirements and meet ANSI A14.3 design requirements.

C. Ladder safety system shall include all necessary components to provide a fully operational system, including one full body safety harness with a 310 lb. weight capacity for each ladder safety system.

D. Ladder safety systems shall be Miller Vi-Go by Honeywell, DBI-SALA Lad-Saf by 3M, or approved equal.

## 2.05 LADDER RETRACTABLE SAFETY EXTENSION

1. Where the Contract Documents indicate fixed ladders are required under access doors and checkered floor plates, they shall be provided with “LadderUp, Model LU-4” by Bilco Company, “L1E Ladder Extension” by Halliday Products Inc., or “Ladder Climb-out Device” by Thompson Fabricating.

2. For access doors, the safety extension shall be manufactured from the same material as the access door with telescoping tubular sections that lock automatically when fully extended.

3. Upward and downward movement shall be controlled by a stainless steel balancing mechanism.

4. Safety extension shall be assembled in strict accordance with manufacturer's recommendations.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

### 3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Aluminum ladder components in contact with concrete or dissimilar metals shall be insulated with an approved dielectric in accordance with Section 09 90 00 – Painting.

**END OF SECTION**

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# SECTION 05 52 00
# GUARDS AND RAILINGS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal guards and railings in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 23 – Metal Fastening

B. Section 05 10 00 – Metal Materials

C. Section 09 90 00 – Painting

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia State Minimum Standard Building Code

2. AA Specifications for Aluminum Structures

3. OSHA Regulations

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all metal work specified herein, sealed by a Professional Engineer currently licensed in the state of Georgia.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

3. Structural calculations on guard and handrail system sealed by a Professional Engineer currently licensed in the state of Georgia.

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## PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used for guards and railings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

### 2.02 METAL FASTENING

A. All welds and fasteners used in guards and railings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

### 2.03 GUARDS AND RAILINGS

A. General – Design of guard and handrail systems is the exclusive responsibility of the Contractor. Guard systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation.

1. All guard systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with AA M12C22A41 finish, unless otherwise noted.

2. Metal railings shall be fabricated from 1-1/2-inch Schedule 40 minimum pipe. Metal railing support posts shall be fabricated from 1-1/2-inch Schedule 80 minimum pipe.

3. The top of the upper guard rail shall be 42 inches above the walking surface for level guards. For stair guards, the top of the upper guard rail shall be 42 inches above the leading edge of the tread nosing. The top of stair handrail shall be 34 inches above the leading edge of the tread nosing.

4. Posts

    a. Maximum horizontal spacing between posts for level rail shall be 6 feet.

    b. Maximum horizontal spacing between posts for stair rail shall be 5 feet.

5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

6. Toeboards

    a. Toeboards shall project 4 inches above the walking surface and shall not infringe on the minimum required walkway width.

    b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

c. Toeboards shall have a minimum thickness of 1/8 inch at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.

7. Expansion joint splices shall be provided at 30-foot maximum spacing and at all expansion joints in the structure supporting the guards.

8. The guard system shall be designed to resist the design loads specified by both OSHA and the International Building Code.

9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the International Building Code.

B. The Contractor shall have the option of providing a guard system of either an all-welded type construction or a component type construction.

1. With both the all-welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.

2. Component Type System

a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.

b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match guard material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.

c. Component type guards shall be as manufactured by Thompson Fabricating Company, Inc., or Hollaender Manufacturing Company, Inc.

3. Welded guards may be field assembled using component type fittings as described herein.

C. Guards shall be either Type I or Type II guards as shown on the Drawings. If no type is indicated on Drawings, guards shall be Type I.

1. Type I guards shall be a two-rail system. The intermediate rail shall be located as required to prevent passage of a 21-inch-diameter sphere at any point.

2. Type II guards shall be a three-rail system with vertical posts spanning between the two intermediate rails.

a. The centerline of the lower intermediate rail shall be 7 inches above the walking surface.

b. The upper intermediate members, whether additional rails or vertical posts, shall be located below the top rail at a spacing as required to prevent passage of a 4-inch-diameter sphere between the two rails.

c. Vertical posts spanning between the intermediate rails shall be 1/2-inch-diameter Schedule 40 pipe or fiberglass rod.

d. Spacing of vertical posts shall be as required to prevent passage of a 4-inch-diameter sphere at any point.

D. Where gates are required in guards as shown on the Drawings, they shall be self-closing and shall be provided by the same manufacturer as the guards. Gates shall swing away from the opening being protected by the guards.

E. Where safety chains are required in guards as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch-diameter, with at least 12 links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be 3/8-inch bolts with 3/4-inch eye diameter welded to the railing posts. Two chains, 4 inches longer than the anchorage spacing shall be supplied for each guarded area.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practical, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. Concrete anchors and bolts for attachment of guard baseplates to supporting members shall conform to Section 05 05 23 – Metal Fastening.

G. All fabricated items shall be shop painted in accordance with Section 09 90 00 – Painting.

## 3.02 INSTALLATION

A. Assembly and installation of guards and railings shall be performed in strict accordance with manufacturer's recommendations.

B. All guards and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Aluminum surfaces in contact with concrete or dissimilar metals shall be insulated with an approved dielectric in accordance with the requirements of Section 09 90 00 – Painting.

**END OF SECTION**

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## SECTION 05 53 00

## GRATINGS, CHECKERED FLOOR PLATES, AND ACCESS DOORS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all gratings and access doors in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 13 – Galvanizing

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Section 09 90 00 – Painting

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia State Minimum Standard Building Code

2. AA Specifications for Aluminum Structures

3. OSHA Regulations

4. ANSI/NAAMM MBG 531 – NAAMM Metal Bar Grating Manual

5. ASTM C1802 – Standard Specification for Design, Testing, Manufacture, Selection, and Installation of Horizontal Fabricated Metal Access Hatches for Utility, Water, and Wastewater Structures

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all gratings, floor plates, and access doors specified herein.

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2. For checkered floor plates, structural calculations signed and sealed by a currently registered Professional Engineer in the state of Georgia verifying the proposed floor plate meets the minimum load and deflection requirements stipulated herein.

3. For access doors provided by a manufacturer not specifically named herein, structural calculations signed and sealed by a Professional Engineer currently registered in the state of Georgia verifying the proposed access door meets the minimum load and deflection requirements stipulated herein. For access doors provided by a named manufacturer, sealed calculations are not required provided the applicable ASTM C1802 load rating is clearly indicated in the submittal for each proposed product.

4. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

## PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used for gratings, floor plates, and access doors shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

### 2.02 METAL FASTENING

A. All welds and fasteners used for gratings, floor plates, and access doors shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

### 2.03 GRATING

A. General: Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.

1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.

2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.

3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 150 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.

4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall be

extruded frames with continuous means of anchoring frames to concrete around entire perimeter of frame. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Grating clips for grating attachment to frames and any other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Grating shall be “IB” by Harsco Industrial IKG, “I-Bar 19SGI4", by Ohio Grating Inc., or “I-Bar” by Thompson Fabricating LLC.

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched planks of extruded aluminum welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. Two stainless steel recessed lifting handles shall be provided for individual panels, one handle at each end, where specifically shown on drawings. All support members shall be aluminum. Plank clips for grating attachment to frames and any other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05 05 13 – Galvanizing.

2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.

3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.

4. Grating shall be manufactured by Harsco Industrial IKG and Ohio Gratings, Inc.

## 2.04 ACCESS DOORS

A. General

1. Door opening sizes, number, and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the dimensions of the openings in the concrete. Clear opening dimensions shall be no smaller than six inches less than the concrete opening.

2. All doors shall be aluminum unless otherwise noted.

3. All door components shall have a minimum tensile yield strength of 23,000 psi and a minimum compressive yield strength of 21,000 psi. Yield strengths shall be indicated on both the structural calculations and the fabrication drawings.

4. Openings larger than 42 inches in either direction shall have double leaf doors.

5. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

6. All doors shall be provided with an automatic hold-open arm with release handle.

7. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.

8. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.

9. All doors specifically required to be watertight shall be installed with a continuous gasket.

10. Access door frames with integral gutter systems shall be equipped with a 1-1/2-inch minimum drainpipe located by the manufacturer. The drainpipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.

11. All doors shall be clearly marked with the information listed below. Markings shall be indicated on metal or plastic tags permanently attached to the door or frame or shall be permanently painted or printed.

    a. The manufacturer’s name or trademark, location, and telephone contact number.

    b. The manufacturer’s model number and ASTM designation.

c. The design load level as indicated in ASTM C1802. If the design requires deviation from the Load Level requirements specified in ASTM C1802, a description of the modifications shall be included.

d. The nominal door opening dimensions and/or the manufacturer's model number.

e. Date of manufacture and/or serial number.

B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4-inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.

2. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

3. All doors shall have an enclosed compression spring assist and open to 90 degrees.

4. Doors not required to support traffic loading shall meet the requirements of ASTM C1802 for Load Level 2 – Pedestrian Load as a minimum and the following:

a. Doors shall be designed to carry a minimum service level live load of 300 psf or a concentrated load of 600 pounds applied over a 5-1/2-inch by 5-1/2-inch area, whichever produces the greatest stress, unless indicated otherwise on the Drawings. Loading shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

b. Live load deflection shall be limited to L/200 of the span, but not greater than 3/16 inch.

c. Unless otherwise noted, exterior doors shall have an integral gutter system and be Type “FDDP” by Nystrom, Type “W1S” or “W2S” by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., or Type "THG" or "THG-D", by Thompson Fabricating LLC, or Type “J-AL” or “JD_AL” by The BILCO Company.

d. Unless otherwise noted, interior doors shall be Type "FDNP” by Nystrom, Type ”S1S” or “S2S” by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., or Type "TH" or "TH-D", by Thompson Fabricating LLC.

5. Doors required to support traffic loadings shall meet the requirements of ASTM C1802 for Load Level 4 – Occasional Truck Traffic, unless otherwise indicated on the Drawings.

   a. For openings less than or equal to 48 inches, the design loading shall consist of a service level 16,000-pound load applied over a 10-inch by 20-inch area with traffic both parallel and perpendicular to the span considered. Loadings shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

   b. For openings greater than 48 inches, two load cases shall be considered. Load Case 1 shall consist of two service level 16,000-pound loads spaced at 48 inches on center with each load applied over a 10-inch by 20-inch area and assuming the traffic direction is perpendicular to the span of the door. Load Case 2 shall consist of two service level 12,500-pound loads spaced at 48 inches on center with each load applied over a 10-inch by 20-inch area and assuming the traffic direction is parallel to the span of the door. Loadings for both cases shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

   c. Live load deflections shall be limited to L/250 of the span, but not greater than 3/16 inch, and shall be determined based off a service level 16,000-pound load.

   d. Unless otherwise noted, doors rated for HS-20 traffic loading shall have an integral gutter system and be Type “FDDH” by Nystrom; Type “H1C”, “H2C”, “H1W” or “H2W” by Halliday Products, Inc.; Type “THS” or “THD” by U.S.F. Fabrication Inc.; Type “THG-H20” by Thompson Fabricating LLC; or “Type JAL-H20” or “JDAL-H20” by The BILCO Company.

## 2.05 FALL THROUGH PREVENTION SYSTEM

A. All checkered floor plates and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except as noted on the Contract Drawings. Checkered floor plates and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300-psf minimum live load, unless noted otherwise.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

### 3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All gratings, checkered floor plates, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.

C. Where access doors utilize leveling bolts, or are placed on irregular surfaces, and are not to be embedded in concrete, the area beneath the frames shall be fully grouted with non-shrink grout to create a uniformly loaded bearing surface.

D. Grating shall not be field cut or modified unless approved by the Engineer.

E. Grating shall not be used for equipment support or anchorage.

F. Aluminum surfaces embedded in or in contact with concrete shall be insulated with an approved dielectric in accordance with the requirements of Section 09 90 00 – Painting.

**END OF SECTION**

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## SECTION 05 55 00
## STAIR TREADS AND NOSINGS

### PART 1 – GENERAL

### 1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all stair treads and nosings in accordance with the requirements of the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 23 – Metal Fastening

B. Section 05 10 00 – Metal Materials

C. Section 05 51 00 – Metal Stairs

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia State Minimum Standard Building Code

2. AA Specifications for Aluminum Structures.

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all work specified herein

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening

### PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used for stair treads and nosings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

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## 2.02 METAL FASTENING

A. All welds and fasteners used for stair treads and nosings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

## 2.03 STAIR TREADS

A. Stair treads shall be aluminum with an abrasive nosing as shown on the Drawings.

B. Stair treads shall be designed for the live load specified in Section 05 51 00 – Metal Stairs.

C. Stair treads shall be as manufactured by IKG Industries, Ohio Gratings, Inc., or Safe-T-Metal Company.

# PART 3 – EXECUTION

## 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

## 3.02 INSTALLATION

A. Assembly and installation of stair treads and nosings shall be performed in strict accordance with manufacturer's recommendations.

B. All stair treads and nosings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

**END OF SECTION**

# SECTION 05 56 00
# CASTINGS

## PART 1 – GENERAL

### 1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 33 05 61 – Utility Structures

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia State Minimum Standard Building Code

### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Complete fabrication and erection drawings of all castings specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

## PART 2 – PRODUCTS

### 2.01 METAL MATERIALS

A. Metal materials used for castings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

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### 2.02 METAL FASTENING

A. All welds and fasteners used for castings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

## 2.03 IRON CASTINGS

A. General - Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, and inlets.

1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.

2. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.

3. Castings shall be as manufactured by Neenah Foundry, EJ USA, J.R. Hoe, John Bouchard & Sons Company, or equal.

B. Covers and Grates

1. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.

2. Round covers and frames shall have machined bearing surfaces.

3. Design Loadings

a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.

b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.

C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

# PART 3 – EXECUTION

## 3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

## 3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All castings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

**END OF SECTION**

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# SECTION 06 10 00
# ROUGH CARPENTRY

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of rough carpentry work shown on the Drawings and specified herein.

B. Principal items of work include:

1. Wood blocking, nailers, grounds, furring, ties, centering, etc., necessary or required for attachment or support of work under this Section and other Sections

2. Fasteners, including nails, screws, bolts, anchors and other fastenings, required to secure work under this Section

3. Temporary enclosures and protective boarding

4. Wood preservative treatment for all wood members in contact with roofing, masonry, concrete, and exposed to the elements

### 1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, rough carpentry work shall conform to the applicable requirements of the following documents:

1. AWPA-CA – Preservative Standards, Lumber and Plywood

2. AWPA-C20 – Structural Lumber Fire-Retardant Treatment by Pressure Process

3. AWPC-C27 – Plywood Fire-Retardant Treatment by Pressure Process

4. AWPA-M4 – Standards for Care of Preservative Treated Wood Products

5. APA – Guide to Plywood Grades

6. FM 1-49 – Perimeter Flashing

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Certifications of Preservative and Fire-Retardant Treatment

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2. Warranty of treatment manufacturer

3. Certification of type and grade of lumber to be used

4. Certification of type, rating and conformance to APA standards

## 1.04 DELIVERY AND STORAGE

A. Take all measures necessary to protect products against damage during delivery and storage.

B. Store lumber in enclosed places in such a manner to provide ventilation and protection from the weather.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. Blocking, Nailers, Grounds, Etc.: Eastern Spruce or Douglas Fir - No. 3 Dimension Lumber or Construction Grade with a moisture content not to exceed 19%

B. Plates, Blocking, and Nailers in Contact with Concrete or Masonry: Pressure-treated southern yellow pine or Douglas Fir

C. Plywood: Identified with APA Grade trademarks of the APA in thickness as shown on the Drawings

1. Exterior: AC-EXT-APA where exposed to view or a finish is required, CD-EXT-APA where concealed

2. Interior: AC-INT-APA where exposed to view or a finish is required, CD-INT-APA where concealed

D. Structural Framing Lumber: Douglas Fir No.1 grade with fb = 1,500 pounds per square inch and E = 1,700,000 pounds per square inch, 19 percent moisture content

E. Fasteners: Provide clamps, connectors, straps, nails, bolts, screws, anchors, ties and other accessories and fasteners shown or required to properly secure all rough carpentry. Fasteners and accessories shall be stainless steel, galvanized, or other noncorrosive metal recommended for use. Fasteners used with pressure treated wood shall be compatible with the wood preservative treatment to prevent corrosion of fasteners.

F. Wood Preservative Treatment: Waterborne pressure treatment in conformance with AWPA Standard P5. Retention shall be in accordance with AWPA standards and be a minimum of 0.40 pounds per cubic foot for contact with or below ground, concrete, or

masonry and 0.25 pounds per cubic foot for above ground. Stamp each piece of treated wood with a trademark identifying the classification of the treatment or a certificate from the processor for each shipment.

G. Fire Retardant Treatment: Fire-retardant lumber and plywood must have an UL stamp signifying a FR-S rating and certifying a 25 or less flame spread and smoke developed value, when tested in accordance to UL 723, ASTM E84, and NFPA 255 "Tunnel Test", and when the test is extended for 20 additional minutes. Treatment formulation shall contain no halogens, sulfates, chlorides or ammonium phosphate. Smoke toxicity shall be no more than that of untreated wood.

## PART 3 – EXECUTION

### 3.01 COORDINATION

A. Coordinate with all trades as to nailers, blocking, grounds and the like required for the attachment of their work and other items requiring same. Carry out all work as required to cooperate work of other trades.

### 3.02 INSTALLATION

A. Perform work in conformance manufacturer's recommendations and specifications, industry, national and local standards and codes.

B. Layout, cut, fit and erect rough blocking, nailers, furring and other rough carpentry. Do cutting work in connection with carpentry and finish for other trades. Brace plumb and level all members in true alignment and rigidly secure in place with sufficient nails, spikes, screws and bolts. Defects which render any piece or part unable to serve its intended purpose shall be discarded or, cut out and replaced.

C. Provide all bracing, supports and shoring required to support construction.

D. Protect all masonry including edges of concrete platforms and similar items. Remove protective covering when directed. Take special precautions at masonry openings and corners of the building.

E. Set all rough hardware, such as plates, spikes, bolts, nails, lag screws, lagging bolts, anchors, etc., as required to hold woodwork together or to anchor or secure it to other materials and construction.

F. Provide wood grounds, nailing strips and similar items wherever necessary or required throughout the project for the support, proper erection or installation of the work and support of mirrors, cabinets, shelf cleats, base and similar items. Thoroughly secure in place by approved means.

G. Secure wood grounds, nailing strips and similar items to metal plugs set in masonry, toggle or expansion bolts. Give the mason all necessary information to enable them to lay out correctly the location for metal wall plugs. Wood plugs will not be accepted.

H. Construct joints to support dead loads, live loads, snow loads, wind loads, or combinations in conformance with National Design Specifications for Stress Grade Lumber and its Fastenings recommended by National Forest Products Association.

I. Nailers and Blocking: Provide and secure wood nailers, blocking, for the reception of roof curbs, roofing, etc. in accordance with FM I-49, or as required by the Building Code, whichever is most stringent. Coordinate attachment with roofing system, where roofing system design includes design of nailers provide attachment in accordance with engineered roofing design.

1. Provide nailers of sizes, shapes and profiles indicated on the Drawings. Nailers shall not be less than 2x6. Build up nailers as required to achieve thickness of insulation or as required to provide proper attachment of roofing and curbs. Provide anchors as required for secure attachment of roofing systems, copings, gravel stops or other edge terminations.

## 3.03 TEMPORARY PROTECTION

A. Provide and install all temporary protection in accordance with applicable provisions of the Contract Documents, OSHA regulations, and as follows:

1. Temporary protection shall include wood doors, railings, protection of floor or roof openings, temporary partitions, and the like; adequately maintained in good repair during the life of the Contract.

2. Furnish and set temporary partitions with wood doors at all exterior doorways, exterior openings or in locations exposed to weather. Substantially build and hang, with proper hinges, locks and other necessary hardware, and remove and reset whenever required to accommodate the work and keep in good repair.

3. Provide substantial temporary wood covering or guards for openings left in floor or roof slabs for ducts, shafts, etc., using rough planking at least 2 inches thick, cleated together and otherwise made sufficiently strong and put in place wherever required immediately after the forms have been removed.

## 3.04 JOB CONDITIONS

A. If the installation of metal frames and glass does not promptly follow the completion of the exterior enclosures, and if the absence of enclosures would cause damage, close in all such openings temporarily by the use of heavy polyethylene plastic sheeting, or canvas stretched over and nailed to frames of 1-inch x 2-inch or heavier strips.

## 3.05 REMOVAL OF TEMPORARY WORK

A. Remove all temporary protection when so directed, or prior to acceptance of the Work.

**END OF SECTION**

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# SECTION 07 21 00
# BUILDING INSULATION

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of building insulation work as shown on Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 – Cast-in-Place Concrete

B. Section 04 20 00 – Unit Masonry

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, building insulation work shall conform to applicable requirements of the following documents:

1. ASTM C578 – Specification for Preformed, Block Type Cellular Polystyrene Thermal Insulation

2. ASTM C665 – Specification for Mineral fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

3. ASTM C726 – Insulation Board, Thermal (Mineral Fiber)

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations

2. Samples of each type of insulation specified

3. Shop drawing for tapered insulation

### 1.05 DELIVERY, STORAGE AND HANDLING

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A. Deliver materials in unopened, undamaged original packaging bearing the manufacturer's name.

B. Store materials in clean, dry, protected areas. Do not leave materials exposed to the weather or sunlight, except to the extent necessary to perform the work.

C. Protect against ignition.

## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the requirements, provide products as manufactured by the following:

1. Extruded Polystyrene Board Insulation
    a. Amoco Foam Products Company
    b. DuPont
    c. UC Industries
2. Polyisocyanurate Foam Insulation
    a. RMax
    b. Atlas Energy Products
    c. Johns Manville
3. Sprayed Polyurethane Foam
    a. Demilec LLC
    b. BASF
    c. NCFI Polyurethanes
    d. Icynene
4. Sprayed Polyurethane Foam (Gap Sealant)
    a. The DuPont
    b. Or Approved Equal

## 2.02 MATERIALS

A. Under Slab and Foundation Wall Insulation: Expanded polystyrene extruded into 2-inch-thick boards for under slabs and over foundation waterproofing, or as indicated on Drawings. Provide insulation conforming to the requirements of ASTM C578, Type IV; with a 5-year aged R-value of 5.

B. Unit Masonry Insulation: Fill ungrouted cells of masonry with foamed in place, two-component thermal insulation. Insulation shall be a Class A material with an R value of 4.9 per inch. Provide CORE-FILL 500 masonry insulation as manufactured by Tailored Chemical Products, Hickory, NC, or acceptable equal.

C. Roof Insulation: refer to Specification 07 60 50.

D. Mineral Wool Batt Insulation: Semi-rigid boards for use as fire stop. Materials shall conform to requirements of UL penetration systems. Mineral wool material shall meet the requirements of ASTM E136.

E. Sprayed Polyurethane Foam: Apply by factory trained or certified installers. Foam blowing agent shall have zero ozone depleting potential, no VOC's and be formaldehyde free. Foam shall be a closed cell with a 2-lb density and provide a minimum R value of 5 per inch. Foam shall be Class I product in accordance with ASTM E84. Exposed surfaces shall be sprayed with an approved 15-minute intumescent barrier or approved thermal barrier.

F. Spray-Applied Slag/Rock-Wool-Fiber Insulation and Self-Supported, Spray-Applied Slag/Rock-Wool-Fiber Insulation: ASTM C764, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications), and Type II (materials containing a dry adhesive activated by water during installation, intended only for enclosed or covered applications). Insulation shall have postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent. Insulation shall have maximum flame-spread and smoke-developed indexes of 5 and 0, respectively, per ASTM E84 and rated as non-combustible as defined by NFPA 220 when tested in accordance with ASTM E136. Provide K-13 Cellulose Spray-Applied Insulation manufactured by International Cellulose Corporation, Houston, TX, or acceptable equal.

G. Adhesive and Fasteners: Type compatible with insulation, masonry, concrete, or other substrate and as recommended or produced by the insulation manufacturer.

H. Sealer and Tape: Type recommended by insulation manufacturer and having perm rating and fire resistance characteristics similar to that of the insulation.

I. Gap Sealant: General Purpose Type: single-component polyurethane sealant. Gun-applied and Straw-applied products, Thermal Value R3.5 per inch. Provide GREATSTUFF PRO™ Gaps & Cracks Insulating Foam Sealant as manufactured by The

Dow Chemical Company or approved equal. Provide Substrate Cleaner as recommended by foam sealer manufacturer.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. Insulation shall be provided in walls, slabs and roofs and where shown on Drawings.

### 3.02 INSTALLATION OF INSULATION

A. Install in accordance with the manufacturer's printed installation instructions to provide maximum sound and thermal benefits for material specified. Install to fill or cover voids. Cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Avoid gaps or bridges.

B. Foundation and Under-Slab Insulation

1. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Stagger vertical joints, except ends over line of expansion joints.

2. On horizontal surfaces, set units level, unless otherwise noted.

C. Cavity Wall Insulation

1. On vertical surfaces of masonry adhere to inner wythe of block.

2. Joints between insulation board units shall coincide with masonry joint reinforcing.

D. Block Insulation: Install foamed in place two component thermal insulation in all ungrouted cells of masonry in exterior walls and interior walls shown on Drawings.

E. Thermal Batt Insulation: Friction fit, with vapor barrier on the warm side, during Winter, of wall between conditioned and unconditioned rooms or spaces. Follow manufacturer's recommendations and instructions.

F. Mineral Wool Batt Insulation: Install insulation in accordance with UL design requirements and in accordance with manufacturer's recommendations.

G. Sprayed Polyurethane Foam: Install in strict accordance with manufacturer’s recommendations. Separate final installation with code approved thermal barrier.

H. Spray-Applied Slag/Rock-Wool-Fiber Insulation: Install in strict accordance with manufacturer’s recommendations.

I. Gap Sealant: Seal all gaps at perimeter of walls and penetrations and openings. Install in strict accordance with manufacturer's recommendations. Remove excess gap sealant to finish flush with the adjacent materials where visible or required to allow installation of finish materials.

## 3.03 ADJUSTMENT AND CLEANING

A. Adequately protect work from damage resulting from subsequent construction operations. Replace damaged or soiled work.

**END OF SECTION**

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# SECTION 07 60 00
# FLASHING AND SHEET METAL

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of flashing and sheet metal work shown on Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04 20 00 – Unit Masonry

B. Section 07 70 00 – Roof Specialties and Accessories

C. Section 07 90 00 – Joint Fillers, Sealants and Caulking

### 1.03 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, flashing and sheet metal work shall conform to the applicable requirements of the following documents:

1. OF-506C – Flux, Soldering, Paste, and Liquid

2. ASTM A176 – Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip

3. ASTM B32 – Specifications for Solder Metal

4. ASTM D1187 – Test Method for Asphalt-Base Emulsions for use as Protective Coatings for Metal

5. SMACNA Architectural Sheet Metal Manual

6. FM Global Data Sheet 1-49 – Perimeter Flashing

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's literature and installation instructions

2. Complete layout and installation drawings and schedules with clearly indicated dimensions

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3. Drawings of proposed flashing

4. Color samples

## 1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a clean dry protected area in such manner to preclude damage by denting, warping, or other distortion.

## PART 2 – MATERIALS

## 2.01 MATERIALS

A. Metal Flashing

1. Exposed to View: Provide prefinished 0.050-inch aluminum. Provide a full-strength Kynar 500 baked-on paint finish with a 20-year warranty. Color to be selected by Owner from manufacturer's standard colors.

2. Concealed from View: Provide a minimum of 22-gauge galvanized steel sheet, stainless steel sheet, or mill-finished aluminum sheet.

B. Nails, Screws, Rivets, Bolts and Other Fasteners: Same material as sheet metal being attached. Nails shall be 18-gauge-diameter shank, 1/4-inch-diameter flat head, annular-thread, diamond point, long enough to penetrate backing by at least 1 inch. Nails shall be spaced 3 inches on center unless other spacing is indicated. Exposed fasteners shall match finish of metal being fastened.

C. Reglets shall be formed of 300 series stainless steel, minimum of 0.020 inch. Reglets shall be Model CO for insertion in concrete, MA-4 for insertion in masonry as manufactured by FRY Reglet Corporation. Corners shall be factory made, mitered and sealed. Furnish reglets to proper trade in sufficient time to be incorporated into the masonry or concrete work.

D. Bituminous plastic cement shall conform to ASTM D4586.

E. Sealants shall be silicone type or as recommended for specific application.

F. Sealer tape shall be polyisobutylene tape specifically manufactured for setting flanges on bituminous roofing or as recommended by roofing manufacturer.

## PART 3 – EXECUTION

### 3.01 FABRICATION

A. Shop fabricate work to greatest extent possible. Comply with details shown and applicable requirements of SMACNA Architectural Sheet Metal Manual and other recognized industry standards. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, and damage or deterioration of the work. Comply with material manufacturer's instructions and recommendations for forming material. Form exposed work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.

B. Roof penetration sheet metal work shall be provided and coordinated with the roofing system. The design and details shall conform to SMACNA Architectural Sheet Metal Manual. Sheet metal items shall be built into roofing in strict accordance with the instructions of the roofing manufacturer.

C. Perimeter flashing related to roof systems shall be installed in accordance with FM 1-49 requirements.

**END OF SECTION**

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# SECTION 07 60 50
# METAL WALL AND ROOF PANELS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENTS

A. Furnish labor, materials, equipment, and appliances required for complete execution of metal wall and roof panels work shown on Drawings and specified herein.

B. Work includes:

1. Metal wall panels, trim, flashing, and accessories associated with a complete and weathertight wall panel system and as indicated on the Drawings

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 07 60 00 – Flashing and Sheet Metal

B. Section 07 70 00 – Roof Specialties and Accessories

C. Section 07 90 00 – Joint Fillers, Sealants and Caulking

D. Section 13 34 19 – Metal Buildings

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Drawings of proposed work, including fastener type and spacing, wall panels, support framing, flashing, trim, and accessory details

2. Manufacturer's product data, specifications, and installation instructions

3. Certification that installer is authorized by manufacturer

4. Drawing showing spacing of fasteners and supports

### 1.04 DESIGN CRITERIA

A. Use the following standards and criteria where applicable in the structural design of the roof support system:

1. Governing Building Code

2. AISC Steel Construction Manual

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3. AISI Cold Formed Steel Design Manual

4. ASCE 7 – Minimum Design Loads for Buildings and Other Structures

B. Design Loads

1. Design loads include live, snow, wind, earthquake, and dead loads, and additional loads required by the Official Code of Georgia.

2. Loads and combination of loads shall be as prescribed and recommended in the standards and codes previously listed herein.

3. Design roof to withstand structural information provided on Structural Drawings and in accordance with building code and any local regulations.

4. Thermal expansion and contraction expected for this location.

## 1.05 WARRANTY

A. Wall and Roof Panels

1. Exterior finish shall be warranted by the manufacturer for 20 years against blistering, peeling, cracking, flaking, checking, and chipping.

2. Color change and chalking shall be warranted for 20 years. Color change shall not exceed 5 NBS units per ASTM D224. Chalking shall be not less than a rating of 8 per ASTM D4214.

## 1.06 QUALITY ASSURANCE

A. Manufacturer shall have been regularly engaged in the fabrication of metal wall panel systems for at least 10 years.

B. Installer shall be authorized by the Manufacturer as trained and qualified to erect the Manufacturer's product.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products from one of the following:

1. AWIP, All Weather Insulated Panels

2. IMETCO

3. King Span

4. Metl Span, a Nucor Company

## 2.02 PRODUCTS

A. Roof Panels

1. 22-gauge aluminum zinc-coated steel sheets factory-finished with two coats of baked-on full-strength (70% resin) fluorocarbon coating system. Color shall be selected by the Owner.

2. Panels shall be standard manufacturer's width (36-42 inch wide by length required to cover roof to minimize end laps. Panel shall be 4 inches thick, minimum R-25 insulated panel.

B. Wall System

1. Fastening system shall be concealed differential thermal movement by the framing system.

2. Provide insulated panels with light profile as required to minimize oil canning.

   a. Exterior Face: 22-gauge aluminum zinc-coated steel sheet

   b. Interior Face: 22-gauge aluminum zinc-coated steel sheet

   c. Color determined by Owner

3. Seal panel termination and perimeter flashing with sealant approved by the manufacturer. Provide trim and support around openings such as light fixtures and similar penetrations through the wall systems.

4. Provide metal closures matching panel profile.

5. Coordinate structural support locations for wall panels. Provide additional structural support, if required by panel manufacturer to resist required design loads.

6. Wall panels shall be 2-inch insulated, minimum R-17, furnished in continuous lengths from top of panel to bottom of the wall panel. Provide top and bottom trim and related closures.

C. Trim System

1. Design trim to provide for expected movement of roof panels due to thermal expansion.

2. Use manufacturer's standard trim pieces, except where field formed pieces are recommended by the manufacturer.

3. Use 0.040-inch aluminum trim with factory finish to match wall panels.

4. Concealed fasteners shall be used to the greatest extent possible. Where exposed fasteners are used, they shall be installed neatly and aligned with other fasteners in straight rows and lines and finished to match roof panels.

D. Accessories

1. Use silicone pipe boots with aluminum sealing ring for openings 12 inches in diameter or less.

2. Provide explosion blow-out panels or fantening method where indicated on drawings.

## PART 3 – EXECUTION

### 3.01 INSPECTION

A. Inspect conditions of structural system and work below. Verify that work is complete to a point where this work can commence and installation can be performed in accordance with the manufacturer's recommendations and instructions. The Contractor shall correct any issues with substrates as required to install wall panels plumb and in alignment and fully supported.

### 3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved shop drawings.

B. Replace damaged or defective items.

**END OF SECTION**

## SECTION 07 70 00
## ROOF SPECIALTIES AND ACCESSORIES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of roof specialties and accessories work shown on Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 06 10 00 – Rough Carpentry

B. Section 07 60 00 – Flashing and Sheet Metal

C. Section 07 90 00 – Joint Fillers, Sealants and Caulking

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, roof specialties and accessories work shall conform to the applicable requirements of the following documents:

1. TT-P-641 (1) – Primer Coating, Zinc Dust - Zinc Oxide (for galvanized surfaces)

2. ASTM A525 – Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process

3. ASTM A526 – Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality

4. ASTM B209 – Specification for Aluminum and Aluminum-Alloy Sheet and Plate

5. SMACNA Architectural Sheet Metal Manual (ASMM)

6. AA Specification for Aluminum Sheet Metal Work in Building Construction

7. AWS

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer’s literature and installation instructions

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2. Samples of each material listed

3. Shop drawings for the full extent of each item to be provided, including overall plans and details of each transition and details of each item

## 1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in factory packed unopened cartons and crating bearing the manufacturer's labels.

B. Store materials in clean, dry protected area in such manner to preclude damage of any nature.

C. Handle all materials with proper care to avoid denting, marring, warping or other distortions during delivery, storage and handling.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. General: Provide roof specialties and accessories of design and construction compatible and approved for use with roofing manufacturer.

B. Fasteners: Provide all fasteners and attachments required to secure item to substrate and support loads required by applicable Building Code. Use only non-corrosive fasteners which are compatible with materials being joined.

C. Colors: Colors shall be selected by Owner from manufacturer’s standard range of colors.

## 2.02 GUTTERS AND DOWNSPOUTS

A. Material: 0.040-inch aluminum.

B. Design: Manufacture gutters tapered and notched to provide telescoping joint. Design gutters and downspouts to accommodate expected thermal movement.

C. Gutters and downspouts shall be sized to meet the Official Code of Georgia and shall be spaced according to the building manufacturer's standards.

D. Supports and Fasteners: Provide manufacturers' standard straps, brackets and fasteners. Place supports and fasteners at 36 inches on center or as recommended by the manufacturer. Finish of supports, brackets and fasteners shall match gutter and downspout.

E. Accessories: Provide end caps, flashing, trim, and other items required for a complete installation.

F. Finish: Baked on Kynar, with 20-year warranty.

## PART 3 – EXECUTION

### 3.01 INSTALLATION – GENERAL

A. Install roof accessories and specialties in accordance with the manufacturer's instructions. Provide a complete watertight and weatherproof installation. Install with provision for expansion and contraction.

### 3.02 DAMAGED MATERIAL

A. Repair or replace materials damaged during installation.

### 3.03 ADJUSTING AND CLEANING

A. Check levels and adjust as necessary after roofing and flashing is complete.

B. Protect materials from damage by other trades. Remove protective coatings at completion of project.

**END OF SECTION**

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## SECTION 07 84 00
## FIRESTOPPING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials and equipment required to complete the installation of troweled or gun-applied firestopping as indicated on the Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 26 - Electrical

B. Division 40 – Process Interconnections

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, firestopping work shall conform to the applicable requirements of the following documents:

1. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials
2. ASTM E119 – Method for Fire Tests of Building Construction and Materials
3. ASTM E814 – Test Method of Fire Tests of Through- Penetration Firestops
4. ASTM E1966 – Standard Test Method for Five Resistive Joint Systems
5. ASTM E2174 – Standard Practice for On-Site Inspection of Installed Fire Stops
6. UL-01 – Building Materials Directory
7. Ul-1479 – Fire Test of Through-Penetration Firestops
8. UL-2079 – Tests for Fire Resistance of Building Joint Systems

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Product data on characteristics, performance, and limitation criteria
2. UL and manufacturer's detail drawings and installation instructions to achieve required fire ratings

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3. Certification that products meet or exceed requirements

## 1.05 QUALITY ASSURANCE

A. A manufacturer's direct representative (not distributor or agent) shall be on-site during initial installation of firestop systems to train appropriate Contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

B. Firestop System installation must meet requirements of ASTM E814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

D. Firestop systems do not reestablish the structural integrity of load-bearing partitions/assemblies or support live loads and traffic. Installer shall consult the Engineer prior to penetrating any load bearing assembly.

E. Engage an installer with a minimum of 5 years of experience and who is certified, licensed, or otherwise qualified by firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL Label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at Project Site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

## 1.07 PROJECT SITE CONDITIONS

A. Do not use materials that contain flammable solvents.

B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

D. Weather Conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products manufactured by one of the following:

1. Hilti, Inc.

2. 3M Corp.

3. Specified Technologies, Inc.

### 2.02 MATERIALS

A. Provide firestopping materials of commercially manufactured products complying with the following minimum requirements and as listed in UL Building Materials Directory.

1. ASTM E84 or UL 723 with a flame spread of 25 or less; smoke development rating of 50 or less; fuel contribution of 50 or less

2. Non-toxic and non-corrosive during each stage of application and during fire conditions

3. Penetrations: ASTM E814 or UL 1479 with 2-hour ratings or as shown on Drawings

4. Joints: UL 2079 2-hour rating or as shown on Drawings

5. Non-combustible when tested in accordance with ASTM E136

6. Materials shall impede the passage of smoke and gases.

B. Backing Material: Unfaced non-combustible mineral wool, or manufacturer prefabricated backer rod, as per UL Building Materials Data.

C. Accessories: Collars, fasteners, straps, and other accessories shall be manufacturer's standard products approved for UL through penetrations.

## PART 3 – EXECUTION

### 3.01 SURFACE PREPARATION

A. Perform preparation and cleaning procedures in compliance with manufacturer's instructions.

### 3.02 INSTALLATION

A. Install firestopping as shown on the Drawings, as specified, and as required by UL system. Firestop the following:

1. Duct, conduit, and pipe penetrations through below-grade floors and time-rated partitions

2. Penetrations of vertical shafts

3. Gaps between fire rated partitions and structure above, or exterior walls

B. Install firestopping in strict accordance with UL through-penetrations systems requirements.

C. Cure finished work as recommended by the manufacturer to avoid shrinkage cracks.

### 3.03 MIXING

A. Mix and prepare materials in compliance with the manufacturer's directions.

B. Store materials in tightly covered containers. Maintain containers used in storage, mixing, and application of firestopping in a clean condition, free of foreign materials and residue.

C. Mix materials to produce a uniform density and as required for application of the materials.

### 3.04 INSPECTION

A. Examine the substrates to receive firestopping and the conditions under which the work is to be performed and notify the Engineer in writing of any conditions detrimental to the proper and timely completion of the work and performance of the firestopping. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the material manufacturer and Engineer.

B. Commencement of firestopping work shall be interpreted as proof of acceptability of the substrates, by the applicator and the applicator's acceptance of responsibility for any failure of bond between installation of firestopping and substrate in any particular area.

C. Do not apply materials over incompatible steel primers, dirt, rust, grease, moisture or other conditions unacceptable according to the manufacturer's instructions.

## 3.05 FIELD QUALITY CONTROL

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174 or other recognized standard.

D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

## 3.06 ADJUSTMENT AND CLEANING

A. Upon completion of work, clean spattered surfaces. Remove spattered materials by methods of washing and scraping, using care not to scratch or otherwise damage finish surfaces. Clean with manufacturer’s recommended solution.

B. Protect work of other trades, whether to be coated or not, against damage by the work. Correct damage by cleaning, repairing or replacing and recoating. Leave all work in undamaged condition.

C. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of firestopping.

**END OF SECTION**

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## SECTION 07 90 00

## JOINT FILLERS, SEALANTS AND CAULKING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for the complete execution of joint fillers, sealants and caulking work shown on the Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 15 00 – Concrete Accessories

B. Section 03 15 16 – Joints in Concrete

C. Section 04 20 00 – Unit Masonry

D. Section 08 80 00 – Glass and Glazing

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C920 – Elastomeric Joint Sealants

2. ASTM D1056 – Flexible Cellular Materials – Sponge or Expanded Rubber

3. SWRI – Sealant and Caulking Guide Specification

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in Article 2.01, Paragraph A herein.

2. Color samples of each type of sealant.

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### 1.05 QUALITY ASSURANCE

A. Applicator shall be a company specializing in the installation of sealants with a minimum of 5 years of experience.

## 1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened labeled packages.

B. Store materials in location protected from freezing or damages.

C. Reject and remove from the site materials within broken or damaged packaging.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.

2. Type 2: Single component polyurethane sealant meeting ASTM C920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.

3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C920, Type S, Grade NS, Class 50, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.

4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by Master Builders Solutions.

5. Type 5: Single component, acrylic latex meeting ASTM C834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by Master Builders Solutions.

6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.

7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.

8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type M, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, MasterSeal CR 195 by Master Builders Solutions.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this Project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.

E. Bond Breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.

F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

## PART 3 – EXECUTION

### 3.01 QUALITY CONTROL

A. Coordinate work with details shown on approved shop drawings prepared by other trades.

B. Verify conditions in the field.

C. Schedule work to follow closely the installation of other trades.

D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.

E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

### 3.02 PREPARATION

A. Protect finished surfaces adjoining by using masking tape or other suitable materials.

B. Clean and prime joints before starting any caulking or sealing work.

C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.

D. Joint Requirements

1. All joints and spaces to be sealed in exterior work shall be less than ½-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.

2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than 1/4 inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the 1/4-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

| | Sealant Depth | |
|---|---|---|
| **Joint Width** | **Minimum** | **Maximum** |
| 1/4 inch | 1/4 inch | 1/4 inch |
| Over 1/4 inch to 1/2 inch | 1/4 inch | Equal to width |
| Over 1/2 inch to 1 inch | 1/2 inch | Equal to width |
| Over 1 inch to 2 inches | 1/2 inch | 1/2 of width |

## 3.03 APPLICATION

A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.

B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.

C. All joints shall be waterproof and weathertight.

D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.

E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.

F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

## 3.04 ADJUSTMENT AND CLEANING

A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

## 3.05 SCHEDULE OF SEALANTS

| Application | Sealant | Color |
|---|---|---|
| Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings | Type 1 | To closely match adjacent surfaces or mortar and as selected by the Owner. |
| Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings | Type 2 | To closely match adjacent surfaces or mortar and as selected by the Owner. |
| Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material | Type 3 | To closely match adjacent surfaces and as selected by the Owner. |
| Masonry expansion and control joints less than 1-1/4 inch wide | Type 2 | To closely match adjacent surfaces and as selected by the Owner. |
| Masonry expansion and control joints equal or greater than 1-1/4 inch wide and not to exceed 2 inches | Type 1 | To closely match adjacent surfaces and as selected by the Owner. |
| Interior wood trim and finish joints | Type 5 | Color to be selected by Owner |
| Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes[1] | Type 4 | To closely match adjacent surfaces and as selected by the Owner. |
| Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit[2] | Type 2 OR Type 3 | To closely match adjacent surfaces and as selected by the Owner. |
| Below thresholds | Type 6 | Manufacturer's standard |
| Horizontal joints exposed to vehicular or pedestrian traffic | Type 8 | To closely match adjacent surfaces. |
| Other joints indicated on the Drawings or customarily sealed but not listed | Type recommended by manufacturer | To closely match adjacent surfaces and as selected by the Owner. |

[1] Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.
[2] Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07 84 00 – Firestopping.

**END OF SECTION**

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## SECTION 08 11 16
## ALUMINUM DOORS AND FRAMES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish and install all flush aluminum doors, frames, and related items, complete and operable, including all finish hardware and appurtenant work, all in accordance with the requirements of the Contract Documents.

### 1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements and applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section

1. AAMA Specifications 2GD-A2HP

2. NAAMM

3. Wind load test in accordance with ASTM E330

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Shop drawings indicating details of construction, and connections

2. Schedules showing sizes, types, finishes, locations, assembly methods, hardware and building location

3. Manufacturer's specifications and installation instructions

4. Certification that doors meet wind design criteria.

### 1.04 DELIVERY, STORAGE AND HANDLING

A. Materials shall be boxed or crated and protected prior to shipment from the factory. Protection shall be arranged to protect all hardware which may be attached.

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## PART 2 – PRODUCTS

### 2.01 ALUMINUM DOORS

A. Provide doors designed and manufactured by Cline, Special Lite, or approved equal.

B. Design doors to resist 26.6-psf wind load.

C. Materials of Construction

1. Standard Face Skins: Smooth, aluminum sheets of 5005-H14 alloy

2. Skin: Minimum 0.024 inch thick, with a minimum tensile strength of 22,000 psi

3. Core: Phenolic-resin impregnated 99# kraft honeycomb

4. Internal Reinforcing Members: Extruded aluminum alloy 6063-T5, minimum wall thickness 0.125 inch

5. Edge Reinforcing Members: Extruded aluminum alloy 6063-T5, minimum wall thickness 0.250 inch

6. Shock Plate: 1/8-inch oil-tempered hardboard

7. Fasteners: Non-corrosive and as recommended by manufacturer

8. Sealants: Non-staining and as recommended by manufacturer

D. Hardware shall be of type recommended and designed for use with door and meet the following requirements:

1. Doors shall be swinging type, with mortise hardware. Cylinder shall be coordinated with Section 08 71 00 – Finish Hardware. Provide weatherstripping at head, jamb and sill.

2. Monorail Door: Provide 0.25-inch-thick neoprene sheet scribe to fit monorail beam. Secure to neoprene to each door leaf.

3. Monorail Door: Provide hook and eye as shown on the Drawings.

E. Louvers: 6063-T5 extruded aluminum alloy and 0.062 thickness. Louver blades shall be inverted.

1. Provide blank off panel full height and width of louver.

## 2.02 ALUMINUM FRAMES

A. Aluminum frames shall be extruded from 6063-T5 aluminum alloy, with a minimum wall thickness of 0.125 inch. Frames shall be designed by the manufacturer to accommodate door and to meet wind load requirements.

B. Adequately reinforce frame to receive hardware. Reinforcements shall be 6061-T6 aluminum and not less than 1/4 inch thick.

## 2.03 ANCHORS

A. Jamb anchors in unit shall be as recommended by manufacturer. Space anchors maximum of 24 inches on center.

## 2.04 FINISH

A. Doors and Frames: High-performance organic coating Kynar/Polyvinylidene Fluoride (PVDF); AAMA 605.2

B. Color: White

# PART 3 – EXECUTION

## 3.01 GENERAL

A. Workmanship and installation shall be in accordance with referenced standards. Field dimensions, conditions, and coordination with adjoining work shall be verified prior to fabrication.

## 3.02 INSTALLATION

A. General: The doors shall be securely anchored in a straight, plumb, and level condition without distortion of frame or panel components and in strict accordance with the manufacturer's published installation details and instructions.

B. Door Operation: Door shall operate freely, smoothly and quietly. Doors shall have a 3/32-inch head and jamb clearances with 1/32-inch tolerance.

**END OF SECTION**

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## SECTION 08 33 23
## ROLL-UP DOORS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of roll-up door work shown on Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08 71 00 – Finish Hardware

B. Section 09 90 00 – Painting

C. Electrical connections for motors, and accessories are specified in Division 26 – Electrical.

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's literature and installation instructions

2. Drawings showing details of the products, connections to adjoining materials, and schedules showing sizes and types

3. Finish and color samples

4. UL certification for fire-rated doors and frames, including oversized doors

### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver products in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Store materials carefully in an area that is protected from the elements, and in a manner that will prevent damage or marring of the door.

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## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with these specifications provide products from one of the following manufacturers:

1. Cornell Iron Works, Inc.

2. Atlas Roll-lite Door Corporation

3. The Cookson Company

4. Overhead Door Corporation

### 2.02 MATERIALS

A. Door Curtains

1. Provide insulated aluminum curtain slats with interlocking sections designed to meet wind load shown on Structural Drawings. Provide high strength endlocks on alternating slats and windlocks as required to meet design wind load. Bottom bar as recommended by manufacturer for type of curtain specified with combination weatherstrip and reversing edge for motor operated doors.

B. Guides

1. Form from galvanized structural steel angles with a minimum 3/16-inch thickness. Provide windlock bars as required to meet design windload. Attach guides to jamb with not less than 3/8-inch steel bolts anchored not more than 30 inches on center.

C. Counterbalance Assembly

1. Counterbalance by means of adjustable steel helical torsion springs, mounted around a steel shaft and mounted in a spring barrel and connected to the door curtain with the required barrel rings. Use grease-sealed ball bearings or self-lubricating graphite bearings for all rotating members.

a. Fabricate spring barrel of hot-formed, structural-quality carbon steel, galvanized welded or seamless pipe, of sufficient diameter and wall thickness to support the roll-up of curtain without distortion of slats and limit barrel deflection to not more than 0.03 inch per foot of span under full load.

b. Fabricate spring balance of one or more oil-tempered, heat-treated steel helical torsion springs.

c. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold the fixed spring ends and carry the torsional load.

d. Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate with bellmouth guide groove for curtain.

D. Door Hoods

1. Formed of 24-gauge galvanized steel with baked on polyester primer. Form to enclose coiled curtain at opening head. Reinforce top and bottom edges. Provide closed ends for surface mounted units. Provide intermediate supports as required to prevent excessive sag.

E. Operation: Provide motor operator with auxiliary hand chain.

1. Endless hot-dip galvanized hand chain of length so bottom of chain is four feet above finished floor. Provide sprockets and reduction gears for ease of operation and a maximum pull of 35 pounds.

2. Provide heavy-duty motor operator with TEFC, high starting torque electric motor, removable without affecting auxiliary hand chain or setting of limit switches. Furnish motor complete with controller, over-current protection and "Open-Close-Stop" pushbutton station shipped loose for surface mounting on interior wall. Motor electrical requirements shall be 480V, 3-phase, 3/4 hp. Motor controller and pushbutton station enclosures shall be rated NEMA 4X.

3. Provide motor controller with entrapment protection consisting of pressure sensing edge seal and photo eye sensors that automatically reverse the door travel. Low-voltage wire/cable shall be furnished for field installation in Contractor-provided conduit.

F. Locks: Provide interlock so electric motor operator will not operate when lock is engaged.

G. Weatherstripping

1. Equip bottom bar with vinyl weatherstrip. Provide motor-operated doors with vinyl sensing/weather edge interlocked with motor to reverse the door if sensing edge encounters an obstruction. Equip end guides with weatherstripping to seal exterior face of door curtain. Equip hood with neoprene air baffle to close top of hood with curtain.

H. Finish

1. Aluminum shall receive manufacturer’s premium powder coat system. Galvanized steel to be chemically cleaned and shop primed. Parts inaccessible after installation shall be given an additional coat in the shop. Color shall be selected by Owner from full range of colors.

## PART 3 – EXECUTION

### 3.01 INSPECTION

A. Examine substrates and adjoining conditions where roll-up door is to be installed. Correct unsatisfactory conditions prior to proceeding with the work.

### 3.02 INSTALLATION

A. Install units and operating equipment complete with necessary hardware, jamb, and head moldings, anchors, inserts, hangers and equipment supports in accordance with final approved shop drawings, manufacturer's printed instructions and as specified herein.

B. Field touch-up shop applied finishes of surfaces scratched or abraded during installation.

C. Do all cutting, drilling, fitting and other work of similar character required for fitting and setting units in connection with this work and adjoining work of other trades.

### 3.03 PROTECTION, CLEANING AND ADJUSTMENT

A. Protect units prior, during and after installation.

B. After installation, lubricate, test and adjust to operate easily and freely from warps, twists or distortion and weathertight fit.

**END OF SECTION**

# SECTION 08 71 00
# FINISH HARDWARE

## PART 1 – GENERAL

### 1.1 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of finish hardware work for openings as shown on Drawings and specified herein.

### 1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08 11 16 – Aluminum Doors and Frames

### 1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, the Work shall conform to the applicable requirements of the following documents:

1. ANSI/BHMA 156

### 1.4 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturers data for each item of hardware. Include installation and maintenance instructions.

2. Furnish templates to fabricators of other work which is to receive hardware.

3. Hardware schedule organized into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other work (such as hollow metal frames) which may be critical in the project construction schedule. Furnish final draft of schedule after samples, manufacturer's data sheets, coordination with shop drawings for other work, delivery schedules and similar information has been completed and accepted.

4. Prepare a keying schedule in consultation with the Owner.

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## 1.5 QUALITY ASSURANCE

A. Provide materials, assemblies, equipment and services from a single source for each category except that locksets, latchsets and cylinders must originate from the same manufacturer.

B. Replace any item of finish hardware which cannot be installed or will not function properly.

C. Provide hardware complying with NFPA 80 and UL Labeled for fire rated openings.

D. Furnish templates or information to door and frame manufacturer. Coordinate between the manufacturers where two or more articles of hardware are to be mounted on the same door. Verify all dimensions, new and existing.

E. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. Handle, store, distribute, protect and install hardware in accordance with manufacturer's instructions or recommendations. Deliver packaged materials in original containers with seals unbroken and labels intact.

B. Properly mark or label, so each piece of hardware is readily identifiable with the approved hardware schedule. Tag each change key or otherwise identifying the door of which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and hardware schedule.

C. Provide secure storage area for hardware.

# PART 2 – PRODUCTS

## 2.1 MATERIALS AND FABRICATION

A. Hand of Door

1. Drawings show swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish hardware for proper installation and operation of door.

B. Manufacturer's Name Plate

1. Do not use manufacturer's products which have name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels.

C. Base Metals

1. Produce hardware units of the basic metal and forming method indicated, using manufacturer's non-corrosive metal alloy, composition, temper and hardness but in no case of lesser quality material than specified.

D. Fasteners

1. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

2. Furnish stainless steel fasteners for installation with each hardware item. Exposed finish (under any condition) to match hardware finish or surfaces of adjacent work. Match the finish of adjacent work as closely as possible, including surfaces to receive painted finish.

3. Provide fasteners which are compatible with unit fastened and the substrate, and which will not cause corrosion of deterioration of finish hardware, base material or fastener.

E. Tools for Maintenance

1. Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance, removal and replacement of builder’s hardware.

F. Hardware Finishes

1. Stainless steel, US32D unless otherwise noted.

2. Closers shall have a USP finish unless otherwise noted.

G. Field Checks

1. Make periodic checks during installation of finish hardware to ascertain the correctness of the installation. After completion of the work, certify in writing, that all items of finish hardware have been installed, adjusted and are functioning in accordance with Specification requirements.

## 2.2 DESCRIPTION OF PRODUCTS

A. Hinges

1. Stainless steel full mortise concealed oil impregnated ball bearing type, five knuckle with non-rising pins for interior doors, and non-removable and non-rising pins for exterior doors. Tips shall be flat.

2. Sizes and Weights of Hinges

    a. Doors Up to 36 Inches: 4-1/2-inch regular weight

    b. Doors 36 to 40 Inches: 5-inch regular weight

    c. Doors 40 to 48 Inches: 5-inch heavy weight

    d. Fire-Rated Doors Up to 36 inches: 5-inch regular weight

3. Provide three hinges per door leaf up to and including 90 inches and one additional hinge for each 30 inches of additional height.

4. Acceptable Manufacturers: Stanley Hardware, Hager Hardware

B. Continuous Geared Hinges

1. Acceptable Manufacturers and Models

| Ives | Hager | Select |
|---|---|---|
| 112HD | 780-112HD | SL11HD |
| 224HD | 780-224HD | SL24HD |

2. Provide one of the previous models of continuous hinges as specified. Coordinate hinge types with the door supplier. Hinges shall be provided by a single manufacturer.

3. Clearance: Coordinate clearance requirements between hinge, door and frame.

4. Fasteners: Per manufacturer's recommendations

5. Material: Aluminum 6063-T6

6. Length: Hinge length shall be full height of door minus manufacturer requirements (1" max).

7. Door Reinforcement: Minimum 16-gauge channel

8. Frame Reinforcement: Minimum 16-gauge channel

9. Provide electric power transfer (EPT) cutouts, or electric through-wire options as specified in hardware groups.

C. Locksets and Latchsets

1. Owner’s Standard: Schlage, Model FE595, Plymouth Trim. Lever type: ELAN. Finish: Satin Chrome.

D. Keys and Keying

1. Owner’s Standard: Schlage, Model FE595 – utilizing both programmable keypad and key operation.

E. Key Cabinet (NOT USED)

F. Panic Hardware

1. Heavy duty push bar exit device, U.L. Labeled, with corrosive resistant construction

2. ANSI A156.3, Grade 1

3. Exterior trim to closely match locksets

4. Single/Active Ddoors: Mortise type

5. Double Doors: Concealed vertical rod

6. ANSI Function 08

7. Acceptable Manufacturer's: Von-Duprin, Adams Rite Manufacturing Company, Corbin/Russwin

G. Closers

1. Cast iron case with seamless one-piece forged steel spring tub

2. Heavy duty forged steel arm

3. Non-sized fully adjustable from size 1 through 6

4. Backcheck intensity and location valves

5. Delayed action closing

6. Full metal cover

7. Mechanical hold open device, except at fire rated doors

8. ANSI 156.4, Grade 1

9. Conforms to ADA 5 lbf maximum door opening force requirement for non-fire rated interior doors

10. Provide mounting brackets and fasteners required for proper attachment.

11. Provide closers at fire rated doors.

12. Acceptable Manufacturers: Corbin/Russwin, LCN, Norton

H. Overhead Door Holder

1. Heavy duty bronze, surface mounted with positive grip holder

2. Track: Extruded bronze

3. Degree of opening: 85 through 110

4. Finish: Satin Chrome Plated

5. Acceptable Manufacturers: Corbin/Russwin, Glynn-Johnson, Norton

I. Door Stops and Bumpers

1. Finish: Satin chrome plated

2. Floor mounted door stops

a. Acceptable Manufacturers and Products: H.B. Ives 444, Hager Hardware Model 267F, and Glynn-Johnson Model FB36

3. Wall Bumpers

a. Acceptable Manufacturers and Products: H.B. Ives Model 407, Hagar Hardware Model 234W, and Glynn-Johnson Model 60C

J. Flush Bolts

1. UL Listed

2. Forged brass construction, 1/2" diameter flattened bolt tip, 12" long rod for doors 7’-4” tall or less. Provide longer rod for taller doors to keep lever approximately 6 feet above floor.

3. Provide flush bolts top and bottom of door.

4. Fit standard ANSI door preparation.

5. Acceptable Manufacturers: Glynn-Johnson, Hager Hardware, and H.B. Ives

K. Automatic Flush Bolts

1. UL Listed

2. Forged brass or stainless steel construction, 1/2" diameter flattened bolt tip, 12" long rod.

3. Fully automatic

4. Provide top and bottom bolts.

5. Operation shall incorporate an override function.

6. Tested for a minimum of 100,000 cycles

7. Provide dust proof strikes

8. Acceptable Manufacturers: Glynn-Johnson, Hager Hardware, and H.B. Ives

L. Push Plates and Pulls

1. Push and Pull Plates: 4"x16"x0.050" stainless steel

2. Pulls: Through bolted, 1" diameter, 2 1/2" projection, 12" centers, stainless steel

3. Acceptable Manufacturers: H.B. Ives, Hager Hardware, and Builders Brass Works

M. Coordinator

1. UL Labeled and tested for 100,000 cycles.

2. Stop mounted, provide filler strips to fully cover stop.

3. Adjustable holding power and override feature

4. Acceptable Manufacturers: Gylnn-Johnson, Hager Hardware, and H.B. Ives

N. Kickplates

1. Stainless steel, 0.050" thick, beveled three sides, 8" high, width 2 inches less than door width

2. Acceptable Manufacturers: H.B. Ives, Hagar Hardware, and Builders Brass Works

O. Silencers

1. Rubber Silencers: Three for each single door and rwo for each double door

2. Rubber silencers at fiberglass door locations shall be self-adhesive type.

3. Acceptable Manufacturers and Products (Hollow Metal Doors and Frames): Glynn-Johnson Models 64 or 65, Hager Hardware Models 308D or 307D, H.B. Ives Models 20 or 21

4. Acceptable Manufacturers and Products (Fiberglass Doors and Frames): H. B. Ives Model SR66 or equal

P. Thresholds

1. Extruded aluminum saddle type and fiberglass for opening with fiberglass door and frames. Provide with stainless steel fasteners, 6 inches wide or as shown on Drawings.

2. Acceptable Manufacturers: Pemko, National Guard Products, Incorporated, and Zero International. Fiberglass threshold by fiberglass door and frame manufacturer.

Q. Door Bottom Seal

1. Extruded aluminum with neoprene seal

2. Acceptable Manufacturers and Products: Pemko Model 57, Zero International Model 328 and National Guard Products, Inc. Model 96

R. Weatherstripping

1. Extruded aluminum with neoprene seal

2. UL Labeled

3. Acceptable Manufacturers and Products: Pemko Model 294, National Guard Products, Inc. Model 190, and Zero International Model 328

## PART 3 – EXECUTION

### 3.1 GENERAL

A. Templates

1. After the hardware schedule is approved, furnish to the various manufacturers required blueprint templates for fabrication purposes. Templates shall be made available not more than 10 days after receipt of the approved hardware schedule.

B. Packaging and Marking

1. Ship hardware with proper non-corrosive fastenings for secure application. Each package of hardware shall be legibly marked indicating the part of the work for which it is intended. Markings shall correspond with the item numbers shown on the approved hardware schedule. Keys shall be tagged within each package set and plainly marked on the face of the envelope with the key control number, door designation and all identification as necessary.

## 3.2 INSTALLATION

A. Install hardware in a manner which will eliminate cracks on surfaces.

B. Mount hardware units at heights recommended in Recommended Locations for Builders Hardware by BHMA, except as otherwise indicated or required to comply with governing regulations.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on the substrate.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as is necessary for proper installation and operation.

E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with factory standards.

F. Cut and fit thresholds and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel which will not corrode in contact with the threshold metal.

H. Set thresholds in a bed of either butyl rubber sealant or polyisobutylene mastic sealant to completely fill concealed voids and exclude moisture. Do not plug drainage holes or block weeps. Remove excess sealant.

## 3.3 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function. Lubricate moving parts as recommended by manufacturer. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application.

B. Final Adjustment

1. At 1 week prior to acceptance or occupancy make a final check and adjustment of all hardware items. Clean and relubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices and compensate for final operation of heating and ventilating equipment.

C. Instruct Owner’s personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

## 3.4 HARDWARE SETS

A. The door hardware sets on the Drawings indicates functional and general requirements. Items shall be quality and finish as specified. Hardware set identification refers to set numbers indicated on the Drawings. Provide hardware required to meet Code requirements. Consult Drawings for set number required.

B. Hardware shall be as follows:

**Table 1: Hardware Sets**

| Set | Items | Set | Items |
|---|---|---|---|
| **1** | 1. Cylinder (Provide Padlocks for Roll Up Doors)<br>2. Remainder of hardware by door manufacturer | **2** | 1. Hinges<br>2. Entrance Lockset<br>3. Overhead Door Closer Holder (each leaf)<br>4. Flush Bolts<br>5. Coordinator<br>6. Kickplate<br>7. Threshold<br>8. Door Bottom Seal<br>9. Weatherstripping<br>10. Astragal w/Weatherstripping<br>11. Panic Hardware |
| **3** | 1. Hinges<br>2. Entrance Lock Set<br>3. Door Closer<br>4. Kickplate<br>5. Threshold<br>6. Door Bottom Seal<br>7. Weatherstripping | **4** | 1. Hinges<br>2. Entrance Lockset<br>3. Overhead Door Closer Holder<br>4. Kickplate<br>5. Threshold<br>6. Door Bottom Seal<br>7. Weatherstripping<br>8. Astragal w/Weatherstripping<br>9. Panic Hardware |

**END OF SECTION**

## SECTION 08 80 00
## GLASS AND GLAZING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of glass and glazing work for openings as shown on Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE (NOT USED)

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the requirements of the Specifications, the glass and glazing work shall conform to the applicable requirements of the following documents:

1. CPSC 16 CFR1201 – Safety Standard for Architectural Glazing Materials

2. ANSI Z97.1 – Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings

3. North American Glazing Association – Glazing Manual

4. UL Building Materials Directory

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Sample of each type of glass and color chart

2. Complete layout and installation drawings and schedules with clearly marked dimensions

3. Manufacturer's technical descriptions and reports for glass and glazing

### 1.05 PROJECT SITE CONDITIONS

A. Check openings to verify that frames are plumb and true, square and secure.

B. Take field dimensions for cutting glass and fabricating units.

C. Do not install glazing when ambient temperature is less than 50 degrees F.

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## 1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in the manufacturer's original unopened labeled containers, clearly marked with their name and brand. Transport large panes of glass in vertical position with spacers to prevent contact between panes and edges.

B. Store glass in a dry, well-ventilated location at a constant temperature, maintained above dew point. Handling shall be kept to a minimum. Protect glass from soiling, condensation or moisture of any kind.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products manufactured by one of the following:

1. PPG Industries
2. Libby – Owens – Ford
3. Cardinal IG
4. Guardian Glass
5. Oldcastle Building Envelope

## 2.02 MATERIALS

A. Primary glass shall meet the requirements of ASTM C1036. Heat treated glass shall meet the requirements of ASTM C1048.

B. Tempered glass shall be plate or float glass tempered by a special heat process and ¼ inch thick or as noted on Drawings. Tempered glass shall meet the requirements of ANSI Z97.1 and Consumer Product Safety Commission 16 CFR 1201. Tempered glass shall be used for all applications, unless otherwise noted.

C. Insulating glass shall be Low-E preassembled units of glass enclosing a hermetically sealed dehydrated air space and certified through the Insulating Glass Certification Council (IGCC) in accordance with ASTM E2190 and ASTM E2188. Glass shall be made from tempered glass or heat-strengthened glass where recommended by manufacturer for application indicated. The unit shall consist of a tinted 1/4" thick exterior light, 1/2" air space and 1/4" thick clear interior light. Sealing system shall consist of metal spacer with bent or soldered corners, butyl primary and silicone secondary seal. Desiccant shall be manufacturer's standard. Exterior pane shall be tinted and color shall

be selected by the Owner from manufacturer's full range of colors. Exterior glass shall be insulated.

D. Impact resistant insulating glass shall be double laminated insulated Low-E preassembled units of glass enclosing a hermetically sealed dehydrated air space and certified through the Insulating Glass Certification Council (IGCC) in accordance with ASTM E2190 and ASTM E2188. Glass shall be laminated glass. The unit shall consist of a tinted laminated 1/4" thick exterior light, 1/2" air space and 1/4" thick clear laminated interior light. Sealing system shall consist of metal spacer with bent or soldered corners, butyl primary and silicone secondary seal. Desiccant shall be manufacturer's standard. Exterior pane shall be tinted and color shall be selected by the Owner from manufacturer's full range of colors.

E. Glazing materials shall be a resilient, non-hardening glazing compound of either a polysulfide or a silicone type. Materials shall not contain any solvents and shall be 100% solids. Oil base putty shall not be used. Glazing compounds shall not be thinned with chlorinated solvents or benzene related compounds. Glazing tape may be used where, and as, recommended by the manufacturer. The color of all exposed glazing materials shall harmonize with the window units.

F. Setting blocks and spacer shims shall be a non-staining material as recommended by the glass manufacturer.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. Determine glass sizes by measuring the frames to receive the glass at the site. Comply with the manufacturer's specified tolerances for each type of glass including cutting tolerance, minimum edge clearance, minimum face clearance, and cover on glass.

B. The edges of all tempered and insulating glass shall be protected from damage and edges shall not be modified in any way after the glass leaves the factory. Nipping of any glass to reduce size shall not be permitted.

C. Deliver glass with manufacturer's labels showing type, thickness and quality of material (and UL Label as required). These labels shall not be removed until the glass is set and final approval has been secured.

### 3.02 INSTALLATION

A. Sheet glass shall be cut and set with waves running horizontally.

B. All glass shall be set in such manner as to avoid possibility of breakage.

C. Rabbets shall be thoroughly cleaned and shall have been prime coated before glass is set.

D. Glass shall be well bedded and back glazed and all surplus compound and markings shall be carefully removed from doors, sash and adjoining work, while still fresh. Compound shall be finished in true, even lines, neatly and smooth faced. Set glass in strict accordance with the manufacturer's printed directions.

E. All glass when set and glazed shall be free from rattle and be watertight.

F. Glazing molds shall be removed and replaced in their correct locations in such a manner as not to mar molding or the screws securing same.

G. Install fire-rated glass in strict accordance with manufacturer’s requirements to meet fire rated assembly shown on Drawings.

## 3.03 PROTECTION AND CLEANING

A. Before and after installation, all work shall be properly protected against damage.

B. On completion and prior to turning the project over to the Owner, all metal work and glass shall be cleaned and left in perfect condition. Glass shall be washed outside and inside.

**END OF SECTION**

# SECTION 08 90 00
# LOUVERS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment, and appliances required for the complete execution of additions, modifications, and alterations to existing buildings and new construction work as shown on the Drawings and specified in the Specifications.

B. Principal items of work include:

1. Fixed type, stormproof louvers and frames

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

### 1.03 REFERENCE CODES, SPECIFICATIONS, AND STANDARDS

A. Without limiting the generality of the Specifications, work shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. Governing Building Code and the requirements of all other authorities having jurisdiction.

2. All units shall conform to AA Aluminum Standards and Data.

3. Louvers shall bear the AMCA Seal with ratings in accordance with AMCA Standard 500 which applies to air performance ratings and water penetration ratings.

4. All louvers, fasteners and supports shall be designed to meet a wind loading in accordance with the local building codes but shall not be less than 25 pounds per square foot.

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Samples

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2. Shop Drawings

B. Samples shall include:

1. Color and finish samples for each finish type required

C. Shop Drawings shall include, but not be limited to:

1. Complete detail drawings showing materials, methods of fabrication and clearly indicating all dimensions

2. Detailed installation drawings showing all methods of attachment

## 1.05 DELIVERY, STORAGE AND HANDLING

A. Brace and support units to prevent deformation during delivery.

B. Factory wrap units with approved materials to protect finish during delivery and storage.

C. Handle units with care to prevent bending or scratching.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products manufactured by the following:

1. Construction Specialties, Inc.

2. Penn, Inc.

3. Airolite Company, Marietta, Ohio

4. Ruskin, Philips Industries, Inc.

## 2.02 FABRICATION

A. Extruded aluminum 6063-T52 alloy, extruded within commercial tolerances and free of defects, minimum 0.081-inch-thick with reinforcing bosses. All corners of frames shall be reinforced and welded.

B. Hardware and fasteners shall be of Type 316 stainless steel placed through nylon bushings.

C. The louver installation shall consist of a fixed exterior louver with frame depth of 6 inches.

D. The fixed louver blades shall be spaced equally not to exceed 4.5 inches and a section thickness of 0.125-inch (frames and blades).

E. Louver assemblies which are to be placed in openings exceeding 5 feet in width shall have slidable interlocked heavy gauge extruded aluminum mullions at mid span of integral tongue and groove construction.

F. Coordinate louver sizes and free area requirements with the HVAC work.

G. Provide 1-inch insulated blanked off sections as required to fill gaps around HVAC equipment, plenums, and ductwork. Finish of blank-off panels shall match louver.

H. Bird screens shall be 1/2-inch square FRP or aluminum mesh PVC-coated, placed in removable 0.081-inch-thick folded aluminum frames standard with the manufacturer.

**2.03 FINISH**

A. Extruded aluminum louvers frames and blades to receive baked on Kynar based coating with a 20-year finish warranty.

B. Interior louvers shall receive alumilite finish 204-R1 as produced by the Aluminum Company of America or equal.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

A. Anchor louver frames using stainless steel bolts into holes drilled and tapped in channel or angle subframes and suspended lintels, or with strap anchors to masonry in accordance with the manufacturer's approved directions.

B. Isolate aluminum from contact with masonry or dissimilar metals with heavy coat of bituminous paint or neoprene gaskets.

C. Mount bird screens on inside face with clips, machine screwed into frames.

D. All frames shall be installed with aluminum (or compatible) screws, bolts, anchors, etc., in such a manner that the frames are removable.

**3.02 CUTTING AND FITTING**

A. Do all cutting and fitting required for the installation in a neat manner.

## 3.03 CLEANING

A. Upon completion remove any and all protective coatings, clean off all parts of the work and leave entire installation in orderly condition.

**END OF SECTION**

# SECTION 09 90 00
# PAINTING

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.

B. Section Includes:

1. Paint Materials
2. Shop Painting
3. Field Painting
    a. Surface Preparation
    b. Piping and Equipment Identification
    c. Schedule of Colors
    d. Work in Confined Spaces
    e. OSHA Safety Colors

### 1.02 RELATED SECTIONS

A. Section 07 90 00 – Joint Fillers, Sealants and Caulking

B. Section 40 05 97 – Piping and Equipment Identification Systems

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications, the painting work shall conform to the applicable requirements of the following documents:

1. SSPC
    a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
    b. SSPC-SP2 – Hand Tool Cleaning
    c. SSPC-SP3 – Power Tool Cleaning

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d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning

e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning

f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning

g. SSPC-SP10/NACE 2 – Near-White Metal Blast

h. SSPC-SP11 – Power Tool Cleaning to Bare Metal

i. SSPC-SP13/NACE6 – Surface Preparation of Concrete

2. ICRI

3. NACE

4. NAPF

5. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus

6. ASTM D1737 – Method of Test for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus

7. ASTM D3359 – Standard Test Methods for Rating Adhesion by Tape Test

8. ASTM D4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

9. ASTM D4263 – Standard Practice for Indicating Moisture in Concrete by the Plastic Sheet Method

10. ASTM D6386 – Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

11. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

12. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using in situ Probes

## 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's literature and Material Safety Data Sheets for each product

2. Painting schedule identifying surface preparation and paint systems proposed. Cross-reference with Tables 1 and 2 herein. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items. Manufacturer shall substitute paint system with equal performance where required for VOC compliance.

3. Surface preparation methods

4. Contractor shall submit Quality Control (QC) Inspection plan describing all tests and inspection tasks to be performed. Include copy of daily log showing environmental conditions measurements and frequency. Copy of completed log shall be provided at completion of Work.

## 1.05 SYSTEM DESCRIPTION

A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.

B. Perform painting work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.

C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.

D. Submerged ferrous metal, piping, and internal pump surfaces within potable water facilities or potable water distribution systems shall be painted with NSF 61/600 approved coatings.

E. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

## 1.06 QUALITY ASSURANCE

A. Painting operations shall be accomplished by skilled craftsman who are licensed by the state of Georgia to perform painting work.

B. Provide a letter indicating that the painting applicator has 5 years of experience and five references which show previously successful application of the specified or comparable

painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

C. Contractor shall coordinate QC inspections.

D. Notify Owner and Engineer at completion of surface preparation, priming application and final cure to allow inspection by Owner and Engineer or their Third-Party Inspector.

### 1.07 STORAGE AND DELIVERY

A. Bring materials to the Project Site in the original sealed and labeled containers.

B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

## PART 2 – MATERIALS

### 2.01 GENERAL INFORMATION

A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.

B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.

C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.

D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.

E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.

F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

## 2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Tnemec Company Inc.

2. PPG

3. CARBOLINE

4. Sherwin-Williams

# PART 3 – EXECUTION

## 3.01 SHOP PAINTING

A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.

B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

C. Coordinate shop painting and field coating to ensure item is delivered and field coating occurs within recoat window of shop painted system requirements.

## 3.02 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.

2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.

3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.

4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.

5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touchup coats are in addition to the specified applied systems, and not considered a field coat.

6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.

7. Field paint shop painted equipment in compliance with color coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level “C” per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.

2. Conform to current SSPC specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.

3. Perform blast cleaning operations for metal when following conditions exist:

   a. Moisture is not present on the surface.

   b. Relative humidity is below 80%.

c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.

d. Painting or drying of paint is not being performed in the area.

e. Equipment is in good operating condition.

f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.

4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.

5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0-mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment or weathering exposure. Provide a 1.5-mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Galvanized metal shall be prepared in accordance with SSPC SP-16. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386 when required by coating manufacturer. Provide a 1.5-mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04 – Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.

9. Prime cleaned metals immediately after cleaning to prevent rusting.

10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.

2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1,000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.

3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6, Section 6, Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 or as required by the coating manufacturer. Moisture vapor transmission shall not exceed 3 pounds per 1,000 square feet in a 24-hour period or less if specified by coating manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1,000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.

4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.

5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric or waterborne epoxy cementitious filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

8. To ease coating around outside corners, provide 3/4-inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of 3/4 inch.

9. Unless recommended otherwise by the coating manufacturer, provide 1/4-inch-deep by 1/4-inch-wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3 inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.

10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5 inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.

11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.

2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.

3. Prime and backprime wood trim before setting in place.

4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.

2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Masonry

1. Cure for a minimum of 30 days prior to paint application.

2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.

3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.

2. Remove dust, dirt, and other contaminants.

H. Previously Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.

2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.

4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

## 3.03 APPLICATION OF PAINT

A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.

B. Apply paint without runs, sags, thin spots, or unacceptable marks.

C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.

D. Special attention shall be given to nuts, bolts, edges, angles, flanges, welds, etc., where insufficient film thicknesses are likely. Stripe paint outside corners and edges in accordance with SSPC PA Guide 11. Stripe painting shall be in addition to coats specified.

E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.

F. Allow paint to dry a minimum of 24 hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.

G. Suspend painting when any of the following conditions exist:

1. Rainy or excessively damp weather.

2. Relative humidity exceeds 85%.

3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.

4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.

5. Surface temperature of item is within 5 degrees of dewpoint.

6. Dew or moisture condensation are anticipated.

7. Surface temperature exceeds the manufacturer's recommendations.

H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07 90 00 – Joint Fillers, Sealants and Caulking.

## 3.04 INSPECTION

A. Each field coat of paint shall be tested and inspected by the Contractor and will be approved by the Engineer or the Engineer’s authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.

B. Use magnetic dry film thickness gauges and wet fiber thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.

C. Coatings shall pass a holiday detector test.

D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly

selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.

E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.

1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

F. Paint manufacturer’s NACE-certified representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

## 3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

A. Use covers, masking tape, other method when protection is necessary or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.

B. Take all necessary precautions to contain dispersion of abrasive blasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the abrasive blasting debris and paint. Suspend painting operations when abrasive blasting debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

## 3.06 PIPING AND EQUIPMENT IDENTIFICATION

A. Piping and equipment identification shall be in accordance with Section 40 05 97 – Piping and Equipment Identification Systems.

## 3.07 SCHEDULE OF COLORS

A. Match colors indicated. Piping and equipment colors are indicated in Section 40 05 97 – Piping and Equipment Identification Systems. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

## 3.08 WORK IN CONFINED SPACES

A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosionproof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state/commonwealth, and local regulations at all times.

## 3.09 OSHA SAFETY COLORS

A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not to exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.

B. Paint hazardous areas and objects in accordance with OSHA regulations.

## 3.10 VOC REGULATIONS

A. Provide paint systems in accordance with local, state, and federal regulations. Where paint systems shown in schedule do not comply, substitute equal products with VOC limits which comply with local, state, and federal regulations.

**Table 1: Painting Schedule**

| Surface | Application | Painting System and No. of Coats | Product Reference (Table 2) | Total Min. Dry Film Thickness (Mils) |
|---|---|---|---|---|
| **Concrete and Masonry** | | | | |
| Interior masonry and concrete walls, columns, beams, and ceilings | All new structures | 1 coat sealer<br>2 coats acrylic epoxy | 101<br>116 | 75-85 sq.ft./gal.<br>4-6/coat |
| Interior masonry and concrete walls, columns, beams, and ceilings in chemical rooms | | 1 coat sealer<br>2 coats epoxy polyamide | 117<br>102 | 60-80 sq.ft./gal.<br>4-6/coat |
| Exterior below grade if interior is dry | Accessible areas (e.g., pipe galleries, pump rooms, basements) | Waterproofing | As directed by Engineer | |
| Submerged or occasional contact with potable or raw water | Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing | 2 coats NSF 61/600 approved epoxy polyamide<br>Provide filler as required and recommended by manufacturer | 105 | 4-6/coat |
| Submerged wastewater | Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing | 2 coats high solids epoxy<br>Provide filler as required and recommended by manufacturer | 119 | 6-10/coat |
| Containment Liner[1] | Interior and exterior secondary containment floors, tank supports and walls | 2 coats high solids epoxy coating | 119 | 6-10/coat |
| **Metals** | | | | |
| Interior and exterior nonsubmerged (gloss) | All new blowers, pumps, motors and mechanical equipment, piping, etc. | 1 coat epoxy polyamide primer<br>1 coat epoxy polyamide<br>1 coat aliphatic polyurethane | 104<br>102<br>115 | 4-6<br>4-6<br>3-5 |
| Interior insulated | | 1 coat acrylic latex | 103 | 4 |
| Submerged or occasional contact with potable or raw water | All metal piping, mechanical equipment, etc. | 2 coats NSF 61/600 approved epoxy polyamide | 105 | 4-6/coat |
| Submerged Wastewater | | 2 coats high solids epoxy | 119 | 8-10/coat |
| Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel), galvanized lintels, | | 1 coat epoxy polyamide<br>1 coat aliphatic polyurethane | 102<br>115 | 5-8<br>3-4 |
| Aluminum surfaces in contact with concrete | | 2 coats coal tar | 107 | 26 |
| Shop Primed Structural Steel | Pre-Engineered Buildings, steel joists | 1 tie coat<br>1 coat epoxy<br>1 coat epoxy | 113<br>114<br>120 | 2-3<br>3-4<br>3-4 |
| **Other** | | | | |
| Interior: Gypsum Wallboard | All new structures | 2 coats acrylic latex matte or satin | 103 | 2-3/coat |
| Interior: Tar-dipped piping where color is required | | 1 coats epoxy resin sealer<br>1 coats epoxy polyamide | 112<br>102 | 2-3/coat<br>5-8/coat |

| Surface | Application | Painting System and No. of Coats | Product Reference (Table 2) | Total Min. Dry Film Thickness (Mils) |
|---|---|---|---|---|
| PVC Piping | | 1 coat epoxy polyamide<br>1 coat aliphatic polyurethane | 102<br>115 | 5-8<br>3-4 |

1 Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

| Table 2: Product Listing | | | | | | |
|---|---|---|---|---|---|---|
| Ref. | System | Purpose | Product | | | |
| | | | Tnemec Series | PPG | CARBOLINE | Sherwin-Williams |
| 101 | Acrylic filler | Primer-sealer | 130-6601 | BLOXFIL 400BF | Sanitile 100 | Pro-Industrial Heavy Duty Block Filler |
| 102 | Epoxy polyamide | Finish coat semi-gloss or gloss | N69 | AMERLOCK 600 (SEMI-GLOSS) | Carboguard 890 | Macropoxy 646 |
| 103 | Acrylic latex | Sealer | 1028/1029 | PITT TECH PLUS | Carbocrylic 3359DTM | DTM Acrylic Primer/Finish |
| 104 | Epoxy Polyamide – metal | Primer | 66 | AMERCOAT 600 | Carboguard 893SG | Macropoxy 646 |
| 105 | Epoxy polyamide | Primer/Finish | 21 | AMERLOCK 2 VOC | Carboguard 61/891VOC | Macropoxy 646 PW |
| 106 | Coal tar epoxy | Finish high-coat build | 46H-413 | AMERCOAT 78HB | Bitumastic 300M | Hi-Mil Sher Tar Epoxy |
| 107 | Coal tar | Sealer | 46-465 | AMERCOAT 78HB | Bitumastic 300M | Hi-Mil Sher Tar Epoxy |
| 108 | Alkyd-medium oil | Finish coat | 2H | HP INDUSTRIAL ALKYD 4308 | Carbocoat 8215 | Industrial Enamel |
| 109 | Alkyd-long oil | Finish coat | 1029 | HP INDUSTRIAL ALKYD 4308 | Carbocoat 8215 | Industrial Enamel |
| 110 | Epoxy polyamide | Primer | 66-1211 | AMERCOAT 600 | Carboguard 893SG | Macropoxy 646 |
| 112 | Epoxy polyamide | Sealer | 66-1211 | AMERLOCK SEALER | Carboguard 893SG | Macropoxy 920 Pre-Prime |
| 113 | Urethane | Barrier coat | 530 | AMERLOCK SEALER | Rustbond | - |
| 114 | Polyamine Epoxy | Intermediate coat | 27 | AMERLOCK 600 | Carboguard 893SG | - |
| 115 | Aliphatic Polyurethane | Finish coat | 1094 or 1095 | PITTHANE ULTRA SERIES | Carbothane 134HG | Acrolon 218HS |
| 116 | Acrylic epoxy | Finish coat | 113 or 114 | AQUAPON WB EP | Sanitile 255 | Pro-Industrial Water-Based Catalyzed Epoxy |
| 117 | Epoxy block filler | Sealer | 1254 | AMERLOCK 400BF | Sanitile 500 | Kem Cati-Coat HS Epoxy Filler |
| 118 | Catalyzed epoxy | Finish coat | 84 | AMERLOCK 2/400 | Carboguard 890 | Macropoxy 646 |

| Table 2: Product Listing | | | | | | |
|---|---|---|---|---|---|---|
| Ref. | System | Purpose | Product | | | |
| | | | Tnemec Series | PPG | CARBOLINE | Sherwin-Williams |
| 119 | High solids epoxy | Finish coat | 104 | AMERLOCK 240 | Carboguard 890 | Dura-Plate 235 |
| 120 | Epoxy | Top coat | N69 | AMERLOCK 240 | Carboguard 890 | - |

**END OF SECTION**

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## SECTION 10 14 00
## IDENTIFYING DEVICES

### PART 1 – GENERAL

### 1.1 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the identifying devices work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Plastic room name and number signs

2. Safety signs

3. Building name or number

### 1.2 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Color and finish samples for all nameplates, signs and building name letters.

2. Shop Drawings shall include, but not be limited to:

a. Complete details for all signs and building name letters giving sizes and styles of lettering and colors

b. Complete schedules for all nameplates, signs, and building name letters giving location, message, letter, size, color, and method of attachment

c. Details of fabrication and attachment of all items

### 1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in unopened, unbroken and undamaged original packaging bearing the manufacturer's label and identification for installation.

B. Handle all materials with care to prevent defacement of any nature.

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Interior Room, ADA Signs, and Site Signage

    a. Mohawk Sign Systems

    b. Inpro Corporation

    c. Schwaab, Inc.

    d. Or equal

2. Exterior and Interior Scheduled Signage

    a. Seton

    b. SafetySign.com, A Division of Brimar Industries, Inc.

    c. Emedco

    d. Or equal

### 2.2 MATERIALS

A. Signs

1. Interior room signs shall be self-extinguishing plastic with raised letters meeting the requirements of the American with Disabilities Act (ADA); total thickness minimum of 0.125 inch; rounded corners. Signs shall be 8-inch x 8-inch or as indicated on Drawings with room name above and room number below.

    a. Character size and style shall be 5/8-inch-high minimum upper case Helvetica. Spacing and proportions of letters shall be in strict accordance with the ADA.

    b. Colors shall be as selected by the Owner from the manufacturer standard colors.

2. Scheduled signs shall be 0.040-inch minimum aluminum with vinyl lettering and numbering.

3. Building signage shall be 12-inch-high laser cut aluminum letters in Helvetica font. Each building shall receive building name generally following naming with

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schedule shown in PART 3 - EXECUTION. Building signage shall be post mounted to building wall.

## 2.3 ACCESSORIES

A. Exterior and Interior Mounting Hardware: Stainless steel screws.

B. Interior Room Name and Signs in Administrative Areas: Tape adhesive, double sided tape, permanent adhesive.

## 2.4 FABRICATION

A. All items specified herein to be factory fabricated to the extent practicable.

B. Provide all attachments and anchors necessary for concealed installments for door numbers, room name plates, and bulletin boards.

# PART 3 – EXECUTION

## 3.1 INSTALLATION

A. All materials specified herein shall be installed in compliance with the approved manufacturer's printed specifications. Mounting devices, bolts, screws, nuts and the like shall be of high strength aluminum or stainless steel. The final location of each sign shall be as determined by the Engineer.

B. Plastic door numbers and room name plates shall be attached stainless steel oval Phillips head screw at each corner.

1. Submit a schedule of door numbers and name plates to the Engineer for approval.

2. Install door and name plates after final field finish has been applied and thoroughly dried.

## 3.2 ADJUSTMENT AND CLEANING

A. After completion of Project, remove all protective devices, touch up as necessary and clean all exposed surfaces with a mild solution of detergent and warm water. Leave all surfaces in a neat and clean condition.

## 3.3 SCHEDULES

A. Fire-Related Signs (ADA Compliant): Provide each sign with wording and pictogram. Signs shall have red background and white letters and pictogram.

| Label | Wording | Size (inches) | Location | Quantity |
|---|---|---|---|---|
| A1 | FIRE EXTINGUISHER | 7x10 | At all fire extinguishers noted on Drawings | 6 |
| A2 | FIRE EXIT | 7x10 | At all fire exits noted on Drawings | 7 |
| A3 | TWO-HOUR FIRE/SMOKE PARTITION – PROTECT ALL OPENINGS | Note (1) | At all fire-rated walls (both sides) as noted on Drawings and as directed by local Authority Having Jurisdiction (AHJ) | Note (1) |
| A4 | TWO-HOUR FIRE/SMOKE FLOOR/CEILING ASSEMBLY – PROTECT ALL OPENINGS | Note (1) | At all fire-rated walls (both sides) as noted on Drawings and as directed by local AHJ | Note (1) |

Notes:
(1) Sign shall be 2.5 inches high x length required. Sign shall be centered and spaced at horizontal intervals of no more than 8 feet or as directed by local AHJ.

B. Informational Signage (ADA Compliant)

| Label | Wording | Size (inches) | Location | Quantity |
|---|---|---|---|---|
| B1 | THERMAL DRYER FACILITY BUILDING | 7x10 | As approved by local AHJ and directed by Owner in field. Each character shall not be less than 4 inches in height and 0.05 inch in width | 4 |

C. Caution signs shall have a yellow background with the word “CAUTION” 2 inches high with black letters and yellow background centered above wording below in black letters. Each sign shall be provided with pictogram showing figure in compliance with sign (i.e., a figure wearing glasses).

| Label | Wording | Size (inches) | Location | Quantity |
|---|---|---|---|---|
| C1 | EAR PROTECTION MUST BE WORN IN THIS AREA | 7x10 | As directed by Engineer in field | 4 |
| C2 | EYE PROTECTION MUST BE WORN IN THIS AREA | 7x17 | As directed by Engineer in field | 4 |
| C3 | HARD HATS MUST BE WORN IN THIS AREA | 7x10 | As directed by Engineer in field | 4 |
| C4 | NON-POTABLE WATER – DO NOT DRINK | 7x17 | At hose bibbs for FE service as shown on Drawings and directed by Engineer in field | 12 |

D. Safety signs shall comply with ANSI Z535 requirements.

| Label | Wording | Size (inches) | Location | Quantity |
|---|---|---|---|---|
| D1 | KEEP DOOR CLOSED FOR FIRE SAFETY | Note (1) | Doors: 261 & 261A | 2 |
| D2 | NO ENTRY<br>AUTHORIZED PERSONNEL ONLY<br>(with pictogram) | 6x3 | Doors: 260, 260B, 260C, 260E, 261, 261A, & 262A | 7 |
| D3 | DANGER HIGH VOLTAGE<br>(with pictogram) | 14x10 | All Electrical Room Doors: 261 and 261A | 2 |

Notes:
(1) Sign shall be 2.5 inches high x length required and centered.

E. Exterior Hazardous Material Building Signage

1. The AHJ shall be consulted regarding the quantity and placement of identification NFPA 704 placard(s) to assist in response to incidents at locations.

| Label | Wording | Size (inches) | Location | Quantity |
|---|---|---|---|---|
| E1 | In accordance with NFPA 704 | 10X10 | All tanks and as directed by Engineer in field and AHJ | 2 |

**END OF SECTION**

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# SECTION 10 43 16
# FIRST AID CABINETS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish and install first aid cabinets as shown on the Drawings and as specified herein. Coordinate work in this Section with painting and marking as specified in Section 09 90 00 – Painting. Certain equipment items will be field located by Owner; if not, install as otherwise shown on the Drawings.

### 1.02 SUBMITTALS

A. Submit Shop Drawings, Operation and Maintenance Instructions, and other information as specified for all items of equipment in this Section in accordance with Section 46 00 00 – Equipment General Provisions and Section 01 33 00 – Submittal Procedures. Shop Drawings shall also include complete erection, installation, and adjustment instructions and recommendations.

### 1.03 MANUFACTURERS

A. The materials covered by this Section are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturers' recommendations.

## PART 2 – PRODUCTS

### 2.01 FIRST AID CABINET

A. The first aid cabinets shall be a Global Industrial First Aid Kit, 2 Shelf Steel Cabinet, ANSI-Compliant, 50-75 Person, Item# T9FB2024169, or equal. First aid cabinets shall be provided as shown on the Drawings. Mounting brackets for masonry mounting shall be provided. Cabinets shall be field located as directed by the Engineer.

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## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. First aid cabinets shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

**END OF SECTION**

## SECTION 10 44 16
## FIRE EXTINGUISHERS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish and install fire extinguishers as shown on the Drawings and specified herein.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of these Specifications, the Work shall conform to the applicable requirements of the following documents:

1. NFPA 10 – Portable Fire Extinguishers

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Complete detail and installation drawings for fire extinguisher cabinets

2. Manufacturer's data sheets and verification of UL ratings

### PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Kidde Fire Extinguisher Company

2. Ansul Fire Protection

3. Potter – Roemer

4. J. L. Industries

### 2.02 MATERIALS

A. Dry Chemical (DC) Fire Extinguishers

1. Provide where indicated on Drawings, 10-lb capacity, hand portable, with wall mount, tri-class dry chemical type, with UL rating of 4-A: 60 BC.

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B. Carbon Dioxide ($CO_2$) Fire Extinguishers

1. Provide, where indicated on Drawings, 10-lb capacity, portable carbon dioxide type with wall mounts, having UL rating of 10-BC.

C. Cabinet: Surface-mounted cabinets #4 finish, Type 304 stainless steel, dual vertical door with 1/8-inch-thick DSA glass size. Doors shall be minimum of ½ inch thick. Hardware shall include pull handle, self-adjusting roller catch and continuous piano hinge constructed of stainless steel.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Fire extinguishers shall be installed where directed by the Engineer.

B. Wall mounts for extinguishers shall be securely mounted to masonry with lag bolts and shields.

C. Fire extinguishers shall be installed so that the top of the fire extinguisher is not more than 5 feet above the floor.

**END OF SECTION**

# SECTION 13 34 19
# METAL BUILDINGS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required by the Metal Building Manufacturer to furnish and install all metal building work. The work shall include, but not be limited to:

1. The building extent shown on the Drawings

2. Clear-span rigid frame systems

3. Louvers, windows, doors, hardware, and skylights

4. Framed openings

5. Metal roof system and wall panels

6. Monorail runway beams and attachment to metal building

    a. Contractor shall be responsible for coordinating with the Metal Building Manufacturer and the monorail manufacturer under Section 41 22 00 – Cranes and Hoists to ensure the design of the metal building incorporates attachment of the monorail runway beams and loading from the beams and trolley hoists furnished under Section 41 22 00 – Cranes and Hoists.

7. All accessories, trim flashing, closures, gutters, downspouts, and all other items not specified under this Section or other Sections but required to provide a completely watertight and functioning building complying with the Specifications

8. Overhead doors, or any other attachments unique to the Project

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 01 – General Requirements.

B. Section 07 60 50 – Metal Wall and Roof Panels

C. Section 41 22 00 – Cranes and Hoists

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## 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.

1. Georgia State Minimum Standard Building Code
2. MBMA Metal Building Systems Manual
3. MBMA Recommended Design Practices Manual
4. AISC Manual of Steel Construction
5. AISI Cold Formed Steel Design Manual
6. AWS Structural Welding Code
7. AA Aluminum Construction Manual
8. SSPC Steel Structures Painting Manual, Vol. 2
9. UL Bulletin of Research No. 52
10. ANSI B30.11 – Safety Code for Underhung Cranes and Monorail Systems
11. All written requirements published by the Metal Building Manufacturer
12. International Accreditation Service AC 472 – Criteria for Inspection Programs for Manufacturers of Metal Building Systems

## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. All design data and calculations shall be neatly prepared to facilitate review and shall be signed and stamped with the seal of a Professional Engineer registered in the state of Georgia and who is a recognized expert in this type of construction. The calculations shall be submitted to the Engineer prior to fabrication and concrete foundation placement.
2. Dimensioned shop drawings showing the building plans including column centerlines, building reactions to the foundation, elevations, and cross-sections.
3. Metal Building Manufacturer's product information, specifications, and installation instructions for building components and accessories.

4. Complete erection drawings showing anchor bolt settings, sidewall, end wall and roof framing, covering and trim details, and accessory installation details to clearly indicate the proper assembly of building components.

5. Comprehensive design for all column baseplates and anchor rods. Anchor rod design shall include quantity and diameter of anchors to transfer metal building reactions. Embedment depth and any necessary additional reinforcement to accommodate loads to foundation will be determined by the Engineer following submittal approval. Submittal shall include maximum factored reactions in tension and compression at each column and any other base connections. Factored reactions shall be for the worse case load combinations to provide the maximum factored reactions in accordance with applicable Building Code and ACI 318 requirements. Load factors used shall be in accordance with ACI 318.

6. 12-inch-long by actual width samples of roofing and siding panels, with required finishes

7. Samples of fasteners for application of roofing and siding panels

8. Samples of sealants and closures

9. Copy of accreditation certificate showing Metal Building Manufacturer’s qualifications per IAS AC 472 as described in Article 1.05 as follows

10. Copy of AISC Certified Erector certification showing the metal building system erector's qualifications as described in Article 1.06 as follows

11. Guarantees described in Article 1.07 as follows

12. Copy of approved shop drawing for monorail runway beams and associated trolley hoists and certified statement indicating the metal building system has been designed to accommodate the connections to the beams and loadings from operation of the trolley hoists

## 1.05 MANUFACTURER'S QUALIFICATIONS

A. The Manufacturer of the metal building systems shall be a manufacturer which has successfully engaged in work of this nature for at least the past 5 years and is an active member of the MBMA.

B. The Metal Building Manufacturer shall be accredited by IAS AC 472 as a certified metal building systems manufacturer.

C. The metal buildings shall be as manufactured by Varco Pruden Metal Building Systems, Memphis, Tennessee; CECO Building Systems, Columbus MS; Butler Manufacturing Company, Kansas City, MO; or American Building Company, Eufaula, AL.

## 1.06 ERECTOR'S QUALIFICATIONS

A. Furnish the names of all erectors proposed to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the erection of metal buildings.

B. Erector qualifications shall include a certified letter from the Metal Building Manufacturer, on the Manufacturer's letterhead, signed by an officer of the company stating that the erector is on the Manufacturer's approved list of erectors.

C. The metal building system erector shall be an AISC Certified Erector.

## 1.07 GUARANTEES

A. Furnish written guarantees from the Manufacturer stating that the exterior paint is guaranteed for a period of 20 years.

B. Paint guarantee shall be against blistering, peeling, flaking, checking, chipping, excessive color change, chalking, and cracking.

C. The roof guarantee shall be against rupture, structural failure, and perforation.

D. Guarantee the roof and wall panels against defects, leaks, etc. and the labor to repair such for a period of 20 years.

E. All guarantees shall be submitted to the Engineer for approval and shall be effective from the date of acceptance by the Engineer.

# PART 2 – GENERAL

## 2.01 GENERAL

A. All work shall conform to the following list which shall be considered as minimum standards:

1. Hot-Rolled Structural Shapes: ASTM A36 or A529

2. Tubing or Pipe: ASTM A500, Grade B and ASTM A501 or A53

3. Plate or Bar: ASTM A529, A572, or A1011

4. Cold Formed Members: ASTM A1008

5. Galvanized Steel Sheet: ASTM A653 Class G90

6. Threaded Steel Rods: ASTM A36 or A572, Grade D

7. Bolts: ASTM A325

8. Anchor Bolts: ASTM F1554

9. Panels: ASTM A792

B. All materials shall be new, unused, free from defect and of American manufacture.

## 2.02 CLEAR SPAN RIGID FRAMES

A. Frames shall be fabricated from hot rolled structural steel, shop welded, built-up "I" shapes consisting of variable depth rafters and either tapered or parallel-flanged columns complete with baseplates and splice plates.

B. Rigid frames shall be designed as pinned base.

C. Width of span and spacing of frames shall be as indicated on the Drawings.

D. Shop drill frames for bolted field assembly.

E. Vertical diagonal bracing shall be permitted only in sidewalls. Horizontal bracing will be permitted providing it is above the building's required interior clear height.

F. Portal frames or wind posts will be permitted where bracing is an obstruction, except where functional interferences are created.

## 2.03 SECONDARY FRAMING

A. Secondary framing shall include but is not limited to purlins, girts, eave struts, endwall posts, trim angles and channels, flange braces, and sag bracing.

B. Framing members shall be a minimum 16-gauge shop painted either cold formed, hot rolled, or built-up steel sections.

C. Purlin and girt configuration, thickness, and spacing shall be the Metal Building Manufacturer's standard provided that all design criteria in the referenced standards including deflection, are met, or exceeded.

## 2.04 ROOF SYSTEM

A. The roof construction shall carry an UL wind uplift Class 60 rating or better to meet the Official Code of Georgia.

B. The metal roof covering shall be 22-gauge (minimum) steel panels with an aluminum-zinc alloy finish designed in accordance with AISI. METAL ROOF COVERING SHALL RECEIVE A 70% KYNAR COATING COLOR TO BE SELECTED BY OWNER FROM PHYSICAL COLOR SAMPLES.

C. Roof panels shall be of "standing-seam interlocking" design, secured to the purlins with a concealed structural fastening system and meeting specified load carrying capacities and allowable deflections.

D. The concealed system shall provide minimal through penetration of the exposed roofing surface and allow the roof covering to move independently of any differential thermal movement by the structural framing system.

E. Except at the concealed fasteners, there shall be no thermal contact of the roof panels with the supporting purlins. Through penetration of the roofing by exposed fasteners shall occur only at terminal locations of the roof panels. Such fasteners shall be stainless steel or aluminum screws, bolts, or rivets, with weather-seal washers. Carbon steel shank fasteners with vinyl heads shall also be acceptable.

F. The standing seams shall have a factory-applied, nonhardening sealant, and the seams shall be continuously locked or crimped together by mechanical means during erection.

G. Roof panels with lay-type side (longitudinal) joints and exposed structural fasteners shall not be considered acceptable.

H. Roof slope shall be as indicated on Drawings.

I. Openings 8" or smaller may be flashed and sealed to the roof panel by elastomeric boots provided complete structural support and weather tightness are maintained.

J. Openings larger than 8" shall be framed with a welded metal roof curb completely supported by the roof system, and with flanges configured to match the roof panel. The curb shall be sealed to provide complete weather tightness.

K. All curbs and boots shall be an integral component of the roofing system designed and supplied by the Metal Building Manufacturer.

**2.05 WALL SYSTEM**

A. Wall panels shall be made of 22-gauge minimum steel with an aluminum-zinc alloy finish designed in accordance with AISI and supplied with a factory applied 70% Kynar coating. Color shall be selected by Owner from physical color samples.

B. Wall panels shall have a regular corrugated profile selected from the Metal Building Manufacturer's standard and meeting specified load carrying capacities and allowable deflections to be approved by the Engineer.

C. Side seams shall be interlocking or concealed.

D. Fasteners shall be concealed from the building exterior except for securing trim, fascias, gutters and miscellaneous flashing.

E. Provide 28-gauge minimum steel linear panels with an aluminum zinc alloy finish and a factory applied coating system. Color shall be selected by the Engineer.

## 2.06 INSULATION

A. Insulation shall be fiberglass batt insulation with vapor retarder liner fabric applied under the metal roof panels at purlins and at wall girts. Basis for Design: Simple Saver System by Thermal Design.

B. The roof insulation shall provide a minimum R value of 25.

C. Thermal spacers shall be provided at all purlins.

D. Wall insulation shall provide a minimum R value of 17.

E. All insulation shall carry an UL fire hazard classified for flame spread no greater than 25.

## 2.07 ACCESSORIES

A. General: Coordinate supply and installation of all accessory items. Coordinate framed opening requirements of accessory items with supplier. Provide special members, fasteners, and hardware required for proper securement and installation of accessory items.

B. Pedestrian doors shall meet requirements of Section 08 11 16 – Aluminum Doors and Frames. Provide header, jamb, and other structural members required for framed opening. Provide trim and flashing required for a weathertight installation.

C. Overhead coiling door shall meet requirements of Section 08 33 23 – Roll-Up Doors. Provide header, jamb, and other structural members and fasteners required for framed opening. Provide trim and flashing required for a weathertight installation.

D. Frame operable louver shall meet requirements of Section 23 00 00 – Basic HVAC Requirements. Provide header, jamb, and other structural members and fasteners required for framed opening. Provide trim and flashing required for a weathertight installation.

## 2.08 SEALANTS AND CLOSURES

A. Sealants shall be asphaltic, nonhardening, non-shrinking, non-staining, noncorrosive and nontoxic.

B. Closures shall match the panel profile and shall be installed as required to provide a weathertight building.

## 2.09 GUTTERS AND DOWNSPOUTS

A. Gutters and downspouts shall be fabricated from 0.040-inch aluminum with 70% Kynar coating. Color shall be selected by Owner from physical color samples.

B. Gutters and downspouts shall be sized to meet the Official Code of Georgia and shall be spaced according to the Metal Building Manufacturer's standards.

## 2.10 MAINTENANCE STOCK

A. Provide a minimum of 5 percent excess over the required amount of metal wall panels, metal roof panel, roof insulation, nuts, bolts, screw, washers, and other required fasteners for building.

B. Pack in cartons and store on the site where directed.

# PART 3 – EXECUTION

## 3.01 DESIGN

A. The building shall be as designed for dead, live, wind, and seismic loads according to the recommendations of the referenced standards.

B. Roof framing shall be designed for an additional live load of 5 psf to accommodate piping and lighting.

C. The building shall be designed for all loads and equipment shown on the Drawings.

D. The building shall be designed to support the monorail runway beams and crane live loads, impact loads, lateral loads and longitudinal loads per the applicable referenced standards.

E. Monorail runway beam deflection limits shall be coordinated with the monorail manufacturer and considered in the building design.

F. The building anchors shall be designed by the Metal Building Manufacturer to resist all column reactions. Anchors shall be furnished by the Contractor and shall be installed per recommendations using the Manufacturer's supplied template.

G. The Engineer will verify the foundation capacity for the factored maximum reactions provided by the Metal Building Manufacturer.

## 3.02 FABRICATION

A. Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly. Fabricate components in such a manner that

once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.

B. Clearly and legibly mark each piece of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

C. Shop connections shall be bolted or welded.

D. Field connections shall be bolted.

## 3.03 PAINTING

A. Materials

1. The painting systems shall be compatible with Section 09 90 00 – Painting.

B. Shop Painting

1. All fabricated steel work and materials shall receive at the factory at least one shop coat of prime paint compatible with the paint system required by Section 09 90 00 – Painting. Surface preparations prior to shop painting shall be as specified. Finish coats may be applied in the shop if approved by the Engineer. All shop painted items shall be properly packaged and stored until they are incorporated in the work. Any painted surfaces that are damaged during handling, transporting, storage, or installation shall be cleaned, scraped, and patched before field painting begins so that the work shall be equal to the original painting received at the shop. Steel work or materials that are to be assembled on the site shall likewise receive a minimum of one shop coat of paint at the factory.

2. The Contractor shall specify the shop paints to be applied when ordering materials to assure compatibility of shop paints with field paints. The paints and surface preparation used for shop coating shall be identified on shop drawings to the Engineer for approval. Where a compatible shop primer is not available, the Contractor shall provide a barrier coat as recommended by field applied paint system manufacturer or shall totally remove shop primer and provide paint system specified in Section 09 90 00 – Painting. Barrier or tie coat shall be in addition to coats required by Section 09 90 00 – Painting.

## 3.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store prefabricated components, sheets, and panels and other manufactured items so that they will not be damaged or deformed.

B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering.

C. Store metal sheets or panels so that water accumulations will drain freely.

D. Do not store sheets or panels in contact with other materials which might cause staining.

## 3.05 ERECTION

A. Erection of metal building, accessories, insulation, and the interior finish, if applicable shall be performed by an AISC Certified Erector in accordance with Article 1.06 previously specified herein.

B. The installation of the metal building shall be coordinated with any work which is to be installed with or attached to the metal building.

**END OF SECTION**

# SECTION 21 05 00
# BASIC FIRE SUPPRESSION REQUIREMENTS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Furnish services, skilled and common labor, and apparatus and materials required for the complete installation as shown and within the intent of the Drawings and/or the Specifications.

2. Requirements of this Section apply to individual Sections in Division 21 – Fire Suppression.

C. Related Sections

1. Division 09 – Finishes

2. Section 23 08 00 – Commissioning of HVAC System

3. Section 26 05 00 – Basic Electrical Requirements

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of bid.

3. Refer to General Conditions and Division 01 – General Requirements for the list of applicable regulatory requirements.

11-20-2024

## 1.03 DESCRIPTION

A. These Division 21 – Fire Suppression Specification Sections define the statutory, administrative, procedural, and technical requirements of the mechanical and controls modifications, replacements, and/or upgrades products and services to be provided on this Contract.

B. Provide fire protection work as indicated on the Drawings and specified in Division 21 – Fire Suppression including:

1. Prepare coordination drawings, shop drawings, submittals, as-built drawings, and operating and maintenance instructions.

2. Determine items and quantities required.

3. Provide complete, continuous, operational, and functioning systems.

4. Fully coordinate with work of other Sections, including field verification of elevations, dimensions, clearance, and access.

5. Repair of damage done to premises as a result of this installation and removal of debris left by those engaged in this installation.

6. Rigging, hoisting, transportation, and associated work necessary for placement of equipment in the final location shown.

7. Disassembly and reassembly of equipment furnished under this Section, should this be required in order to move equipment into final location shown on the Drawings.

8. Labor, materials, tools, appliances and equipment that are required to furnish and install the complete installation for this portion of the Work including that which is reasonably inferred.

9. Cooperation with other crafts in putting the installation in place at a time when space required is accessible.

10. Temporary scaffolding necessary for performance of fire suppression work.

11. Cutting and core drilling required for work of Division 21, including locating of rebar or coordination of locating rebar.

12. Pipe sleeves for holes in walls, floors, and ceilings, and cutting of floor slabs and slabs on grade.

13. Waterproofing where necessary for installation under Division 21.

14. Cooperation with and assistance to the itoring and Control System Subcontractor as required to provide a complete and functional HVAC control system.

15. Counterflashing of roof penetrations for work of Division 21.

16. Sizes, and locations for installation of curbs and pads for work of Division 21.

17. Temporary and permanent stands and supports for equipment requiring them including vibration isolation.

18. Temporary protection of existing installation.

19. Stenciling and equipment identification.

20. Firestopping of penetrations of ducts, piping, and conduits through walls, floors, and ceiling assemblies.f

21. Temporary utilities as required to install work o Division 21 including lighting, water, gas, electricity, etc.

22. Fees, permits, inspections, taxes, and approach from agencies that have jurisdiction over installation of Division 21.

23. Participation in and coordination with the Commissioning process.

24. Warranty.

## 1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's technical product specification sheets for each system component and device to be provided that includes data needed to prove compliance with this Section. Clearly indicate the exact model of each component to be provided.

C. Shop Drawings: The Subcontractor shall submit for approval shop drawings prepared in accordance with Section 01 33 00 – Submittal Procedures and as required by other Sections of the Specifications.

1. Shop drawings shall be drawn to a scale of 1/4 inch = 1 foot (1:25) or larger, and shall include complete dimensions, locations, elevations, and clearances for plumbing, piping, ductwork, equipment, and valve numbers.

    a. Prepare in AutoCAD format or as otherwise directed.

b. Identify equipment using designations shown on the Contract Documents or as directed by the Engineer. Do not proceed with identifications without approval from the Engineer.

2. All shop drawings shall clearly call out in bold letters and cloud symbols deviations from the Specifications and Drawings, no matter how minor.

D. Coordination Drawings

1. Obtain drawings from the structural, electrical, sprinkler, plumbing, sheet metal, concrete, steel, and dry wall trades.

2. Hold regular coordination sessions with trades until coordination issues are resolved.

3. Prepare separate composite coordination drawings to a scale of 1/4 inch = 1 foot (1:75) or larger, showing work of Divisions to demonstrate coordination, clearance, access, etc. between ductwork, equipment, temperature controls, cable trays, conduits, light fixtures, piping, plumbing, structural elements, architectural elements, etc. These drawings are to be the basis for the detailed shop drawings and need not be submitted but are to be available for review upon request.

a. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

b. Each trade is to adjust their shop drawings based on the outcome of coordination sessions.

4. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work.

5. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

6. Indicate the proposed locations, of piping, ductwork, equipment, and materials. Include the following:

a. Clearances for installing and maintaining insulation.

b. Clearances for servicing and maintaining equipment, including specific ceiling tile or ceiling access panel access and space for equipment disassembly required for periodic maintenance.

c. Equipment connections and support details.

d. Fire-rated wall and floor penetrations.

e. Sizes and location of required concrete pads and bases.

f. Valve stem movement.

g. Sizes and locations of new and existing equipment support curbs on roof.

h. Sizes and locations of new openings, either sleeved, cut, or core-drilled, in new concrete construction unless specifically shown on the Structural Drawings.

7. Maintain one complete set of composite coordination drawings at the job site. Periodically update drawings based on actual field conditions.

8. Submit final coordination drawings as part of record document requirements.

E. Submit manufacturer's operation and maintenance (O&M) manuals in compliance with Section 01 78 23 – Operation and Maintenance Data. Include a list of spare parts that the manufacturer recommends the Owner purchase.

F. Lateral Force Anchorage: Submit lateral force anchorage calculations and details of anchorage of components to building including backing design. Seismic forces shall be in accordance with the requirements of the Structural Drawings and Specifications with value 1.5 used as the minimum CBC seismic importance factor, Ip. Calculations shall be sealed by a Structural Engineer registered in the state of Georgia.

G. Record Documents: Upon completion of the work covered by this Contract, as directed, furnish the Owner with as-built drawings as specified in Division 01 – General Requirements. Include changes installed under this Contract which are not in accordance with the Contract Drawings. Note that these as-built drawings are to be based on the Contract Drawings. In addition, submit final copies of the Shop Drawings and Coordination Drawings.

## 1.05 QUALITY ASSURANCE

A. Materials and Equipment: Materials and equipment shall be new. Materials and equipment for which tests have been established by UL shall be approved by that body and shall bear its Label of approval.

1. The first-named manufacturer and product is the basis of design. other manufacturers and/or products shall be considered to be substitutions.

B. In lieu of listing by an approved testing laboratory, consideration will be given to certified test reports of an adequately equipped, recognized independent test laboratory competent to perform such testing indicating conformance to requirements of the applicable UL standards.

C. Unless otherwise approved by the Engineer, the materials to be furnished under this Section shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to the material specified, and shall be the manufacturer's latest standard design that complies with the specification requirements.

D. Approval of Materials

1. Division 01 – General Requirements regarding requirements for materials and equipment and submittals.

2. A complete list of materials and equipment proposed shall be submitted to the Engineer for approval. The list shall include for each item: the manufacturer, the manufacturer's catalog number, type or class, the rating, capacity, size, etc.

3. Before installation of the equipment, the Contractor shall submit for approval detailed construction drawings for each item of fabricated equipment required for installation. Drawings shall be to scale and fully dimensioned and shall provide sufficient detail to clearly indicate the arrangement of equipment and its components.

4. Installation of approved substituted equipment is the Contractor's responsibility, and changes required to work included under other Divisions for installations of approved substituted equipment must be made to the satisfaction of the Engineer and without change in Contract Price. Approval by the Engineer of substituted equipment and/or dimension drawings does not waive these requirements.

## 1.06 STARTUP TRAINING

A. Prepare a formal training program for Owner’s personnel prior to the scheduled start-up date. The program shall consist of the design, startup, and operation of the fire protection system. Coordinate the training program with the production of the Operation and Maintenance (O&M) manuals. Provide indexed binder and training materials to each participant.

B. Provide on-site training for the duration(s) specified in Section 01 79 00 – Instruction of Owner’s Personnel in the operation and maintenance for installed system and major piece of equipment. Systems include fire protection and Facilities Monitoring and Control System. Trainers shall be experienced, manufacturer-approved personnel.

1. Schedule training for each system in advance with the Owner.

2. Include travel, per diem and incidental costs for personnel under contract to the Contractor.

3. O&M manuals shall be available for training sessions.

## 1.07 RULES AND REGULATIONS

A. Comply with requirements of Division 01 – General Requirements.

B. Provide work and materials in full accordance with the latest rules of the organizations listed in Division 01 – General Requirements and in other Sections of Division 21 – Fire Suppression, and with prevailing rules and regulations pertaining to adequate protection and/or guarding of moving parts, or otherwise hazardous locations.

C. Whenever the Drawings and Specifications require something which will violate the regulations, the regulations shall govern. Review the Drawings and Specifications and request from the Engineer clarification or revision of portion of the work in violation of the rules or regulations prior to installing the portion of work. Necessary installation alteration required for compliance shall be made at no additional cost to the Owner.

D. Whenever the Drawings and Specifications require larger sizes or higher standards than are required by the regulations, the Drawings and Specifications shall govern.

E. Strictly conform to the requirements of NFPA, NEC, OSHA, Fire Marshal, and the Owner’s insurance underwriters' requirements. Expenses required shall be borne under this Contract.

## 1.08 PROTECTION OF EQUIPMENT

A. Protect, handle, and store products under provisions of Division 01 – General Requirements.

B. Assume responsibility for damage to the Work or premises before Substantial Completion. Should new or existing equipment become damaged, restore it to its original condition and finish before Final Acceptance. Damage incurred to the Owner’s property or to the work of other Divisions caused by the work under this Division shall be replaced or repaired by, and at the expense of, the Contractor to the satisfaction of the Owner. Exposed materials shall be clean at the time of acceptance of the Project.

## 1.09 SCHEDULING AND SEQUENCING

A. Cooperate with other trades in putting this installation in place at a time when space required is accessible and in such a manner that other work in this space may be installed as shown on the Drawings. Schedule work and cooperate with the others to avoid delays, interferences, and unnecessary work, conforming to the construction schedule, making the installation when and where directed.

1. Include labor and materials to install certain items furnished under this contract when required by the schedule. These items are part of this Contract but may need to be installed only after completion of work under another contract which this Contractor may or may not be participating in. It is the responsibility of the Contractor to coordinate with others to ensure that preparations are made and

ready to accept the installation of these items. These items include, but are not limited to:

a. Air inlets and outlets

b. Temperature sensors

c. Monitoring and control panels

d. Sprinkler heads

B. If a discrepancy is discovered between Drawings, whether with respect to a significant variance between location, variation in quantity, or violation of code requirements, notify Engineer for clarification and do not proceed with the work affected until clarification has been made.

C. Schedule work in advance with the Owner. No system shall be shutdown unless approved in writing.

## 1.10 TEMPORARY USE

A. Should it become necessary to use the new portion of the system and the new equipment to warm or air condition part of the building before the completion of this work, the Owner reserves the right to make use of same at its own risk and expense, but the temporary use of the equipment shall not constitute an acceptance of the plant or part thereof in way. The Owner will bear the cost of fuel and electricity for such temporary use of the equipment. If temporary use of new systems or equipment is solely for the benefit of the Contractor, Contractor shall bear the cost of fuel and electricity for such temporary use.

## 1.11 WARRANTY

A. Comply with Division 01 – General Requirements.

B. Provide extended warranties where specifically required in subsequent Sections of Division 21 – Fire Suppression.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. In addition to material and equipment specified, provide incidental materials to result in a complete installation. Such incidental materials include solders, tapes, caulkings, mastics, gaskets and similar items.

B. Materials and equipment shall be uniform throughout the installation. Equipment of the same type shall be of the same manufacturer. Materials and equipment shall be new.

## 2.02 MATERIALS AND SUBSTITUTIONS

A. Comply with Division 01 – General Requirements regarding specified items and substitutes.

# PART 3 – EXECUTION

## 3.01 EXAMINATION OF SITE

A. The Subcontractor shall examine the site and become familiar with conditions that may affect the work covered by Division 21 – Fire Suppression of the Specifications.

B. Arrange to meet with the Owner at the Project Site before the Work has started and discuss with them the various phases of the work and the procedure and preparation for testing and adjusting the systems.

C. The general arrangement and location of piping ductwork, apparatus, etc., is shown on the Drawings or herein specified. Minor changes may be necessary to accommodate other work, new or existing, that may conflict with this work. Install this work in harmony with these trades and fully coordinate work.

D. Visit the Project Site, take measurements, examine areas where work is to be performed and get such other information necessary for proper execution of the work. Ascertain and check conditions with the Drawings and Specifications, other trades, existing conditions and by what means the work is to be performed. No allowance shall subsequently be made for extra expense due to failure or neglect to make such examination and correlation. Where revisions or changes in the existing work are required to permit the installation of new work, they shall be made at no additional cost to the Owner. No allowance shall be subsequently made for error or omission.

## 3.02 ACCURACY OF DATA

A. The Drawings indicate the general arrangement and location of piping, ducts, and equipment. Should it be necessary to deviate from arrangement or location indicated in order to meet architectural conditions or site conditions, or due to interference with other work, make such deviations as offsets, rises and drops in piping and ducts that may be necessary, whether shown or not, without extra cost to the Owner. Extreme accuracy of the data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for the assistance and guidance of this Section and exact locations, distances, and elevations shall be governed by actual site conditions.

## 3.03 COORDINATION ITEMS

A. Coordinate mechanical work with that of other trades in order to:

1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.

2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.

3. Indicate aisleways and accessways required on coordinated shop drawings for roof equipment area, mechanical equipment rooms, data and telecommunications rooms, corridors, ceiling spaces, shafts, corridors, ceiling space, laboratories, etc.

B. Understanding of Work

1. Study, examine, and compare the Contract Documents, including Drawings and Specifications. The Subcontractor shall have a full understanding of how the work in this part is scheduled, phased, and installed with work of other trades.

2. Include in this installation piping, ductwork, devices, and equipment that are necessary for complete and operating systems as specified and as required.

3. Connect piping and ductwork from fixtures, outlets, and devices full size to the nearest suitable main or riser.

4. Certain installations may be presented as typical, and full details are not repeated for each case. Subcontractor shall provide complete installation as if full details apply to each and every case and make adjustments to typical details to suit each specific installation as part of the basic work.

5. Installation of work presented on the diagrams are applicable to the plans, and work depicted on the plans are applicable to the diagrams.

6. If there is a discrepancy in the Drawings or Specifications, the Contractor shall plan the work based on the most stringent requirements to complete the installation and obtain clarification from the Engineer before installation.

C. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.

2. Verify dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. Work shall be above ceilings or ceiling line.

7. Coordinate installation and connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Coordinate with individual system requirements.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as is practical, connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

12. Coordinate with the locations of electrical panels and avoid installing piping and ductwork over them. Electrical panels are purposely located and have priority for location. The Contractor is responsible for required piping and ductwork offsets to ensure that the panels are located as designed and for other conditions.

13. Perform system modification recommended by Test and Balance Agency after recommendations are accepted by the Owner.

## 3.04 WORKMANSHIP AND SUPERVISION

A. Comply with the following:

1. General Requirements: Section 01 14 00 – Coordination with Owner’s Operations.

2. Division 01 – General Requirements for quality control, in addition to the following:

    a. Measurements: Materials installed shall be to exact field measurements.

    b. The installation depicted on the Drawings is designed to fit tightly into work under other Sections or Divisions. It is the essence of this Contract that work be completely coordinated with other Sections or Divisions, and that locations of pipes and ducts be exactly determined in the field and cleared with other Sections or Divisions before the installation of these items is begun. No extra compensation will be made for failure to observe this clause.

    c. Adequate clearance for access to operable devices and automatic devices and for access to lubrication points shall be maintained in portions of the work including ductwork and piping installed on the roof. Tripping hazards shall be avoided.

    d. Provide architectural access doors where shown and where required for access to equipment and operable devices.

    e. Gauges, thermometers, and other indicating devices shall be installed so that they can be easily read from the floor.

## 3.05 MATERIAL DELIVERY AND STORAGE

A. Comply with Division 01 – General Requirements.

## 3.06 INSTALLATION

A. Manufacturer's Directions: Follow manufacturer's directions covering points not shown on the Drawings or specified herein. Manufacturer's directions do not take precedence over Drawings and Specifications. Where these are in conflict with the Drawings and Specifications, notify the Engineer for clarification before performing the specific work.

B. Carpentry, Cutting, Patching, and Core Drilling

    1. Provide carpentry, cutting, patching, and core drilling required for installation of material and equipment specified in Division 21 – Fire Suppression.

    2. No penetrations shall be sleeved, cut, or core drilled through concrete construction without a submittal indicating exact locations and sizes and specific written approval from the Owner or unless specifically shown on the Structural Drawings.

    3. It is the Subcontractor's responsibility to accurately size and locate openings through the structure. The dimensions shown on the Structural Drawings are for general information only. Provide specific sizes, dimensions, requirements, etc.

C. Seismic Mounting

1. Material and equipment, including floor mounted equipment, piping, and appurtenances shall comply with Division 01 – General Requirements.

D. Waterproof Construction

1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior roof penetrations. Caulk penetrations of foundation walls and floors watertight. Provide membrane clamps at penetrations of waterproof membranes.

2. Provide waterproof NEMA 3R enclosures for equipment or devices mounted outside or otherwise exposed to the weather.

E. Sleeves, Stubs, and Slab Penetrations: Refer to Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment.

F. Painting of Mechanical Equipment and Hardware

1. Comply with applicable portions of Division 09 – Finishes for paints and coatings.

2. Provide moisture-resistant paint for exterior painting.

3. Colors shall be as shown on the Drawings unless specified.

4. Comply with individual Sections for other equipment to be painted.

5. Repair damaged galvanizing, paint, or coatings. Use Z.R.C. (no known equal) cold galvanized compound for galvanized repairs.

G. Concrete Equipment Bases

1. All equipment located on concrete floor inside the building or on grade outside the building, shall be mounted on a concrete base. The concrete base shall be 4 inches high and shall extend 6 inches beyond the edge of equipment base unless indicated otherwise on Drawings.

2. Coordinate Concrete Bases: Concrete bases indicated on Architectural Drawings or Structural Drawings are specified in other Divisions. Concrete bases not on Architectural Drawings or Structural Drawings are requirements of this Division.

## 3.07 PIPING AND EQUIPMENT IDENTIFICATION

A. Comply with Section 21 05 53 – Identification for Fire Protection, Mechanical Process, and Life Safety System Equipment.

## 3.08 VIBRATION

A. Vibration levels shall not exceed vibration criteria listed in Section 21 05 48 – Vibration and Seismic Controls for Fire Suppression Piping and Equipment.

B. If vibration problems are a result of improper material or installation, these conditions shall be corrected by the Subcontractor at no cost to the Owner.

## 3.09 SHUTDOWN AND SCHEDULING

A. Comply with Division 01 – General Requirements.

## 3.10 PROTECTION OF EQUIPMENT

A. Care shall be exercised during construction to avoid damage or disfigurement. Equipment shall be protected from dust and moisture prior to and during construction. The Subcontractor is cautioned that concrete finishing, painting, etc. in electrical rooms shall not proceed if unprotected equipment is installed.

B. Where required or directed, construct temporary protection for equipment and installations for protection from dust and debris caused by construction.

C. All protection shall be substantially constructed with the use of clean canvas, heavy plastic, visqueen and plywood as required, and made tight and dust proof as directed.

D. The Subcontractor shall repair by spray or brush painting, after properly preparing the surface, scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

E. Failure of the Subcontractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

## 3.11 INSPECTIONS

A. Comply with Special Conditions and Division 01 – General Requirements.

## 3.12 REMOVED EQUIPMENT AND MATERIALS

A. Comply with Division 01 – General Requirements.

## 3.13 CLEANING

A. Comply with Division 01 Section Special Procedures - Cleaning.

## 3.14 LUBRICATION

A. All lubrication points shall be accessible. Where this is impossible, provision shall be made for lubrication at an accessible location. Where oil is used, an oil level indicator

and capped, vented filling connection shall be provided and firmly mounted in an accessible space and shall be connected to the bearing with pipe(s) as required. Where grease is used for lubricant, the pipe shall have a suitable lubricating fitting installed at the accessible end. Equipment shall be thoroughly lubricated before operation and at time Work is accepted.

## 3.15 SEALANTS

A. See Division 07 – Thermal and Moisture Protection for sealing duct, pipe, and conduit penetrations through walls, partitions, and floors.

1. Completely seal duct, pipe and conduit penetrations through rated and non-rated walls.

## 3.16 TESTS

A. Upon completion of the mechanical work, perform tests and provide test reports as specified in this and other Sections.

1. All tests shall be made in the presence of a representative of the Engineer. The application or interruption of mechanical utilities shall be programmed and directed by the Engineer.

2. The Subcontractor shall submit to the Engineer three copies of test results, certified in writing, witnessed, signed and dated, immediately upon completion of work. Unsatisfactory conditions revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be corrected by the Subcontractor to the satisfaction of the Engineer.

3. The Engineer reserves the right to require that the Contractor perform and repeat tests that are deemed necessary to complete or check the tests or the certified records of the Subcontractor during the course of the work. Correct unsatisfactory portion of its work that is revealed by the tests or that may be due to progressive deterioration during this period, unless the item in question was a direct specification.

## 3.17 COMMISSIONING

A. Perform commissioning requirements of:

1. Division 01 – General Requirements

2. Section 23 08 00 – Commissioning of HVAC System

3. Section 26 05 00 – Basic Electrical Requirements

B. Commissioning is included as a part of the total package of quality assurance and quality control for this Project. Commissioning is to be integrated into the Project as the

process that oversees and verifies the functional performance of equipment, systems, and assemblies via observation and testing. Include coordination with and full participation in the commissioning process. Commissioning shall include but not be limited to field observations, factory and site tests, pre-start checks, startup checks, functional test procedure review, functional testing, commissioning meetings, documentation, test interpretation, and deficiency correction. The details of these requirements are described in the previously listed Sections and other referenced Sections and are hereby incorporated by reference into the work under Division 21 – Fire Suppression.

## 3.18 MAINTENANCE AND OPERATING INSTRUCTIONS AND TRAINING

A. Refer to Division 01 – General Requirements, for maintenance and operating instructions and training requirements.

B. At time of occupancy, arrange for manufacturer's representatives to instruct Owner’s personnel in the use of equipment. Arrange for personnel to be instructed at one time. Costs for this service shall be included in the Contract.

**END OF SECTION**

## SECTION 21 05 29

## HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Pipe, duct, and equipment hangers and supports

2. Anchors, equipment bases and supports

3. Sleeves and seals

4. Flashing, counter flashing and pipe stacks

5. Firestopping

C. Related Sections

1. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

2. Division 03 – Concrete

3. Section 07 84 00 – Firestopping

4. Section 07 90 00 – Joint Fillers, Sealants and Caulking

5. Section 21 05 48 – Vibration and Seismic Controls for Fire Suppression Piping and Equipment

6. Section 22 11 13 – Facility Water Distribution Piping

7. Section 23 31 13 – Metal Ducts and Duct Accessories

11-21-2024

## 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of bid.

3. Refer to General Conditions and Division 01 – General Requirements for the list of applicable regulatory requirements.

4. Refer to Section 21 05 00 – Basic Fire Suppression Requirements for codes and standards and other general requirements.

B. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

C. NFPA

1. NFPA 13 – Installation of Sprinkler Systems

2. NFPA 14 – Installation of Standpipe and Hose Systems

D. SMACNA

1. Seismic Restraint Manual: Guidelines for Mechanical Systems for the support of ductwork

E. UL Fire Resistance Directory

## 1.03 SUBMITTALS

A. Submit under provisions of General Conditions, Division 01 – General Requirements and Section 21 05 00 – Basic Fire Suppression Requirements for quality assurance.

B. Submit calculations showing compliance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components for each piece of equipment whether supported or braced from above or below.

C. Submit calculations showing compliance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components for seismic bracing of ductwork and piping.

D. Submit shop drawing for hanger and support spacing, framing and attachment methods.

E. Submit firestopping systems for every application.

## 1.04 QUALITY ASSURANCE

A. Comply with Section 21 05 00 – Basic Fire Suppression Requirements.

B. Supports for Sprinkler Piping: Comply with NFPA 13.

C. Supports for Standpipes: Comply with NFPA 14.

D. Do not use black steel devices, components, fasteners in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.

# PART 2 – PRODUCTS

## 2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 (12.7 mm) to 1-1/2 Inch (38 mm): Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.

B. Hangers for Pipe Sizes 2 Inches (50.8 mm) and Cold Pipe Sizes 6 Inches (152.4 mm) and Greater: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.

C. Hangers for Hot Pipe Sizes 6 Inches (152.4 mm) and Greater: Adjustable steel yoke, cast iron roll, double hanger.

D. Trapeze Supports: 12-gauge (2.67-mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and cast iron roll and stand for hot pipe sizes 6 inches and greater.

E. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12-gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping and adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and greater.

F. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.

G. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

H. Floor Support for Hot Pipe Sizes 6 Inches (152.4 mm) and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

I. Shield for Insulated Piping 2 Inches and Smaller: 18-gauge (1.31-mm) galvanized steel shield over insulation in 180 degree segments, at least 12 inches (300 mm) long at pipe support.

J. Pipe Shields: Pipe Shields Inc., FRI, or equal, pipe hanger shield with waterproofed calcium silicate insulation encased in a galvanized metal casing completely around the pipe. Provide insulation at same thickness as pipe insulation. Furnish the following models:

1. Chilled Water: A2000 with calcium silicate insulation extending 1 inch beyond the metal casing

2. All others: A1000

K. Concrete Anchors: In accordance with Section 03 15 00 – Concrete Accessories.

## 2.02 DUCT SUPPORTS

A. See Section 23 31 13 – Metal Ducts and Duct Accessories.

## 2.03 HANGER RODS

A. Steel, threaded both ends, threaded one end, or continuously threaded.

## 2.04 ATTACHMENTS TO STRUCTURE

A. Inserts for New Formed Concrete Construction: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods

B. For Suspension from New Formed Concrete Structure: Grinnell Figure 282, Superstrut 452, or equal, UL listed for the rod sizes, Grinnell, Fig. 282, Superstrut 452, or equal

C. Connection to Existing Concrete Structure: Concrete anchors conforming to Section 03 15 00 – Concrete Accessories

D. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert

E. For Support on New Concrete: Galvanized steel headed bolts

F. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment

G. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load

## 2.05 SUPPORTS, BRACING, AND ACCESSORIES

A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.

B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.

C. Sheet Metal Screws: Plated, size 10 minimum.

D. Pre-engineered duct and pipe bracing systems shall be Mason Industries Seismic Sway Brace System or equal.

## 2.06 COUNTER FLASHING

A. Metal Flashing: 26-gauge galvanized steel

B. Flexible Flashing: 47-mil-thick sheet butyl; compatible with roofing

C. Caps: Steel, 16-gauge

## 2.07 EQUIPMENT CURBS

A. See Architectural Drawings and Structural Drawings for the design details for the equipment curb.

## 2.08 SLEEVES

A. Adjust-To-Crete, AMI Products, or equal, 24-gauge, electro-galvanized adjustable sleeve, up to 6-inch- (150-mm-) diameter. For 8 inches (200 mm) and larger, provide galvanized standard weight steel pipe sleeves.

B. Sleeves for Round Ductwork: Form with galvanized steel.

C. Sleeves for Rectangular Ductwork: Form with galvanized steel or wood.

D. Caulk: Acrylic sealant of quality specified in Section 07 90 00 – Joint Fillers, Sealants and Caulking.

## 2.09 FIREPROOFING OF FLOOR AND WALL PENETRATIONS

A. Materials and installation shall comply with UL Fire Resistance Directory for Through-Penetration for Firestop Devices. See Section 07 84 00 – Firestopping.

## 2.10 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers for installation without disengagement of supported pipe.

## 2.11 FINISHES

A. Prime-paint exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

   1. Steel in an interstitial space is considered exposed.

B. Hot-dip galvanized outdoors.

C. Repair damage to galvanizing at welds, scratches, etc. using Z.R.C. (no known equal) cold galvanizing compound.

# PART 3 – EXECUTION

## 3.01 ATTACHMENTS TO STRUCTURE

A. Concrete Structure: Locate anchors from any edge condition and at a spacing to obtain maximum working loads specified in the applicable ICC report.

   1. See Structural Drawings for additional restrictions for locating anchors.

B. Steel Structure: Attach at beam axis. Avoid eccentric loads wherever possible.

C. Rating: Ultimate strength at least 5 times the imposed load.

D. Submit for review all pipe hanger locations, point loads and structural attachment details for pipes 6 inches (152.4 mm) and larger.

E. Coordinate installation so that attachments to structure are made prior to fireproofing. If attachments must be made after fireproofing, then thoroughly clean area of fireproofing before welded or bolted attachments are made and replace fireproofing as necessary. Fireproofing material shall match existing.

F. Where point loads imposed by work of Division 21 – Fire Suppression are greater than can safely be carried by the roof or deck, provide structural steel spreader beams tied to the building structure. Submit details of all such spreader beams for approval.

G. Inserts

1. Furnish inserts per Division 03 – Concrete for placement in concrete formwork.

2. Furnish inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Furnish hooked rod per Division 03 – Concrete.

4. Reinforcement for inserts carrying pipe larger than 4 inches (101.6 mm).

5. Where concrete slabs form finished ceiling, furnish inserts to be flush with slab surface.

6. Where inserts are omitted, submit an attachment plan to the Engineer.

## 3.02 SUPPORTS, BRACING, AND ACCESSORIES

A. Common Support Systems: This Section covers the provision, coordination, calculations, and seismic bracing of support systems common to Division 21 – Fire Suppression work. Work under individual Sections shall provide their own horizontal support struts. The work under Division 21 shall be coordinated with the work of other Divisions regarding all aspects of hanger installation, horizontal strut installation, pipe/conduit/cable tray/etc. installation, seismic bracing installation, and so on.

B. Set all machines and devices dead level, except where pitch or slope is specified or shown. Securely fasten to the structure unless shown otherwise. Use dry pack cement grout to obtain complete contact between structure and equipment.

C. This Section covers the concrete work for the support of equipment provided under this Section. Coordinate locations with anchor bolts before concrete is placed.

D. Pipe Hangers and Supports

1. Support horizontal piping as follows:

| Pipe Size | Maximum Hanger Spacing | Hanger Diameter |
|---|---|---|
| 1/2- to 1-1/4-inch (12.7- to 31.75-mm) | 6.5 feet (2 m) | 3/8-inch (9.5-mm) |
| 1-1/2- to 2-inch (38.1- to 50.8-mm) | 10 feet (3 m) | 3/8-inch (9.5-mm) |
| 2-1/2- to 3-inch (63.5- to 76.2-mm) | 10 feet (3 m) | 1/2-inch (12.7-mm) |

| Pipe Size | Maximum Hanger Spacing | Hanger Diameter |
|---|---|---|
| 4- to 6-inch (101.6- to 152.4-mm) | 10 feet (3 m) | 5/8-inch (15.9-mm) |
| 8- to 12-inch (203.2- to 304.8-mm) | 14 feet (4.25 m) | 7/8-inch (22.2-mm) |
| 14-inch (355.6-mm) and Greater | 20 feet (6 m) | 1-inch (25-mm) |

2. Install hangers to provide at least 1/2 inch (13 mm) of space between finished covering and adjacent work.

3. Place a hanger within 12 inches (300 mm) of each horizontal elbow.

4. Use hangers with at least 1-1/2 inch (38 mm) of vertical adjustment.

5. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.

6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers. Use specified pipe shields (if applicable). Trapeze size and support size and spacing shall be governed by the cumulative weight of the supported piping. Maximum trapeze deflection shall be 1/240th of the span on a maximum stress of 15,000 psi (103.5 MPa), whichever is more stringent.

8. Support riser piping independently of connected horizontal piping.

9. Brace piping longitudinally and transversely as specified and indicated on the Drawings. Design of the seismic bracing shall be in accordance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

10. Support all pipe from the building structure so that there is no apparent deflection in pipe runs. Fit piping with steel sway braces and anchors to prevent vibration and/or horizontal displacement under load when required. Do not support from, or brace to, ducts, other pipes, conduit, or any materials except building structure. Piping or equipment shall be immobile and shall not be supported or hung by wire, rope, plumber's tape, plastic ties, or blocking of any kind. Vertical piping running between floors shall be additionally supported at midpoints in a rigid and immobile fashion. Any exposed or concealed piping which can be physically moved, and which is not properly supported will not be accepted, and additional support or bracing will be required. Install seismic bracing as at locations as shown on the Drawings.

11. Install and secure all equipment with anchors and braces to floors, structural members and walls with sufficient backing, to prevent vibration and/or horizontal displacement under load and seismic force as hereinbefore specified. Follow manufacturer's recommendations for the installation of vibration isolators where required for all equipment requiring such.

E. Equipment Bases and Supports

1. Comply with Division 03 – Concrete for concrete bases.

2. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

3. Construct support of steel members. Brace and fasten with flanges bolted to structure. Level equipment installed on steel rails using shims to compensate for the deflection of the steel.

4. Provide rigid anchors for pipes after vibration-isolation components are installed.

F. Counter Flashing

1. See Architectural Drawings for flashings.

2. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors, and roofs.

3. Counterflash vent and soil pipes projecting at least 3 inches above finished roof surface with lead worked at least 1 inch into hub, at least 8 inches clear on sides using 24- x 24-inch (600- by 600-mm) sheets. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.

4. Counterflash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides using at least 36- x 36-inch (900- by 900-mm) sheets. Fasten flashing to drain clamp device.

5. Seal floor, shower, mop sink, and drains watertight to adjacent materials.

6. Provide acoustical-lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

7. Provide curbs for mechanical roof installations at least 14 inches (350 mm) high above roofing surface. Counterflash with flexible sheet and counterflash with sheet metal; seal watertight.

G. Sleeves

1. Set sleeves in position in formwork. Provide reinforcing around sleeves.

2. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves full depth and provide floor plate.

3. Where piping or ductwork penetrates floor, ceiling, or wall, close-off space between pipe or duct and adjacent work with fire-stopping insulation and caulk airtight. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.

4. Install chrome-plated steel escutcheons at finished surfaces.

## 3.03 SEISMIC RESTRAINTS

A. Provide all support hangar system, equipment, ductwork and piping with seismic restraints in accordance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components .

B. Pipe seismic restraints shall not interfere with pipe thermal expansion loop action or pipe building joint expansion loop action.

**END OF SECTION**

# SECTION 21 05 48
# VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general conditions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Inertia bases

2. Vibration isolation

C. Related Sections

1. The requirements of this Section apply to all individual Specification Sections in Division 21 – Fire Suppression.

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of bid.

3. Refer to General Conditions, Supplementary Conditions, and Division 01 – General Requirements for the list of applicable regulatory requirements.

4. Refer to Section 21 05 00 – Basic Fire Suppression Requirements for codes and standards, vibration and noise, and other general requirements.

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## 1.03 SUBMITTALS

A. Submit under provisions of Section 21 05 00 – Basic Fire Suppression Requirements – for review of materials, Section 01 33 00 – Submittal Procedures, and General Conditions.

B. Product Data

1. Provide specific information for items described under PART 2 - PRODUCTS of this Section, including specifications, descriptive drawings, catalog cuts, and descriptive literature, including make, model, dimensions, weight and interface description with other work, and indicating full compliance with specified requirements as outlined.

2. An itemized list showing items to be isolated, the isolator type, model number, isolator loading and deflection, and reference to specific Drawing showing frame construction where applicable.

C. Shop Drawings

1. Indicate inertia bases and vibration isolator locations, with static and dynamic load on each.

2. Drawings showing intended locations.

3. Drawings showing equipment frame construction for each machine, including dimensions, structural member sizes, and support point locations.

4. Drawings showing methods for suspension, of support, and guides.

5. Drawings showing methods for isolation of piping, at penetrations of walls, slabs, etc.

D. Operations and Maintenance Data: Submit manufacturer's certificate that isolators are installed and adjusted to meet or exceed specified requirements.

## 1.04 QUALITY ASSURANCE

A. Maintain ASHRAE criteria for average noise criteria curves for equipment at full-load condition.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Mason or M.W. Sausse

B. Isolation equipment shall be supplied by a single manufacturer. The following model numbers are Mason's. Vibration isolation components (isolators, snubbers, rails, and inertia bases) to be hot-dip galvanized. Welded steel channel perimeter frame with welded-in reinforcing bars, prelocated welded-in anchor bolts or prelocated bolt holes suitable for the number and size required, and height saving brackets where required. Inertia bases shall be 1.5 times of the weight of the equipment. Snubbers shall be provided. Delete inertia base requirement if the equipment is provided with motor rating of less than 15 hp and is provided with steel frame base.

C. Type "A" Support from Below with Spring Isolators: Model SSLFH captive spring mount for seismic and restrained service with leveling bolts, corrosion resistant finish, and 1/4-inch (6-mm) ribbed neoprene base pad. Provide optional baseplate with bolt holes where required. Furnish vibration isolation products from a single manufacturer. The only exception is internal vibration isolation that is integral with the equipment, such as internal isolators on air handling units.

D. All vibration isolation components (isolators, snubbers, rails, and inertia bases) to be hot-dip galvanized.

## 2.02 VIBRATION ISOLATORS

A. General

1. Metal parts of vibration-isolation units shall be as follows:

   a. Housing: Hot-dipped galvanized outdoors, and inside air handlers and painted indoors. Galvanizing shall meet ASTM salt spray test Standards and Federal Test Standard No. 14.

   b. Hardware (Washers, Nuts, Bolts, etc.): Galvanized outdoors and inside air handlers, and cadmium-plated indoors.

   c. Springs: Neoprene-coated outdoors and inside air handlers, and painted indoors.

2. Isolator types are scheduled to establish minimum standards. At the Subcontractor's option, accessories may be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevation during installation and initial system filling operations, and similar installation advantages. Accessories shall not degrade the vibration isolation system.

3. Static deflection of isolators shall be as indicated in Vibration Isolation Schedule. Static deflections stated are the minimum acceptable deflection for the mounts under actual load.

4. The use of nested springs or of multiple parallel springs within a single mount is not permitted.

B. Unit FSN (Floor Spring and Neoprene)

1. Spring isolators to be free-standing and laterally stable without housing. Spring diameter shall be not less than 0.8 times the compressed height of the spring at the design load. Springs shall have a minimum additional travel to solid equal to 50 percent of the actual deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately 1. Mounts shall have leveling bolts.

2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene. A rectangular bearing plate of appropriate size to load the pad uniformly in the range of 40 to 50 psi shall be provided. A neoprene friction pad and a stainless steel, aluminum, or galvanized steel plate shall be used between the friction pad and the isolator. The isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.

3. Unit FSN isolators shall be one of the following products, or equal:

a. Type SLF: M.I.

b. Type FDS: K.N.C.

c. Type AC or AD: V.M.C.

C. Unit HS (Hanger Spring)

1. Vibration-isolation hangers shall consist of a free-standing laterally stable steel spring set into a neoprene cup, contained within a steel housing. The neoprene cup shall be manufactured with a grommet (or other element) to prevent the hanger rod from contacting the hanger housing. A steel washer shall be provided in the neoprene cup to evenly distribute load onto the neoprene.

2. The plate or washer at the top of the spring shall be welded to the spring. The hanger rod shall be securely fastened to this plate or washer using lock nuts. The hanger rod shall have a diameter not less than 5/8 inch. This design represents a modification to the unit types given below. The modification is intended to limit the side-to-side motion of the hanger rod relative to the hanger casing.

3. Spring diameter and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the housing. Spring elements shall have minimum additional travel to solid equal to 50 percent of the actual deflection.

4. Upper hanger rod attachment shall be made through a neoprene rubber-in-shear element designed to avoid direct contact between the hanger rod and the isolator frame.

5. Springs shall be color coded for ease of identification and removable, for field connection.

6. Unit HS isolators shall be one of the following products or equal:

    a. Type 30N (modified): M.I.

    b. Type SH (modified): K.N.C.

    c. Type RSH (modified): V.M.C.

## 2.03 EQUIPMENT BASES

A. Unit BSF (Base Steel Frame)

1. Steel base frames shall consist of structural steel sections sized, spaced, connected, and cross-connected to form a rigid base which will not twist, deform, or deflect in any manner which will negatively affect the operation of the supported equipment of the vibration-isolation mounts. Frames shall be adequately sized to support basic equipment units and mounts plus associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. The depth of steel frame bases shall be at least 1/10 the longest dimension of the base with a minimum depth of 6 inches (150 mm), but not more than 12 inches (300 mm). Frame bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.

2. Unit BSF base shall be supplied by the isolator manufacturer and shall be one of the following products or equal:

    a. Type WFSL: M.I.

    b. Type SFB or SRB: K.N.C.

    c. Type WFB: V.M.C.

B. Unit CIB (Concrete Inertia Base)

1. Concrete inertia bases shall be formed of stone-aggregate concrete (150 pounds per cubic foot) and appropriate steel reinforcing cast between perimeter structural steel channels. Inertia bases shall be built to form a rigid base which will not twist, deform, or deflect, in any manner which would negatively affect the operation of

the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base depth shall be at least 1/12 the longest dimension of the inertia base but not less than 6 inches (150 mm) and not more than 12 inches (300 mm). The weight of the inertia base, as a minimum, shall be 1 to 2 times that of the total weight of the equipment, as scheduled (including the attached piping it is supporting and other applicable loads). Inertia bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.

2. The steel frame and reinforcement are to be supplied by the vibration isolator manufacturer. Concrete shall be provided in the field.

3. Inertia bases used to support vibration-isolated pumps are to be sized to provide support for valves, pipe elbows and suction diffuser.

4. Frame and reinforcement for Unit CIB bases shall be one of the following products or equal:

   a. Type KSL: M.I.

   b. Type CIB-L or CIB-H: K.N.C.

   c. Type WPF: V.M.C.

## 2.04 SNUBBERS

A. Snubbers to limit the vertical and horizontal motion of the isolated equipment shall be fabricated from steel. A neoprene pad, 1/4-inch minimum thickness, shall be affixed at the point of contact. There will be no contact between snubbers and the inertia base or equipment support frame during normal operation. Minimum of one snubber per side, four total, shall be required on each base. Seismic snubbers shall have a minimum of 1.0G ratings and anchorages.

B. Snubbers shall not be finally installed until vibration isolators are in place and adjusted with actual operating loads.

C. Model Z-1225 for installations within the maximum seismic load requirements consistent with the manufacturer's recommendations, and Model Z-1011 for greater seismic load requirements, manufactured by M.I., Model HS-4 manufactured by K.N.C., or equal.

## 2.05 PIPING ISOLATORS

A. Specialty Products Co. Acousto-Plumb isolators for pipe 3/4 inch (20 mm) and smaller, and Trisolator for pipe 1 inch (25 mm) and larger, or equal.

# PART 3 – EXECUTION

## 3.01 GENERAL

A. The Subcontractor shall obtain inspection of installation to be covered or enclosed prior to such closure.

B. The Subcontractor shall obtain written and/or oral instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices.

C. The Subcontractor shall correct, at no additional cost, installations which are deemed defective in workmanship or materials.

D. The Subcontractor is responsible for proper operation of systems, minor sub-systems, and services provided under this Section. The Subcontractor shall coordinate startup procedures, calibration, and system check-out with other Subcontractors involved. Any system operational problems shall be diagnosed. Correctional procedures shall be initiated by the various Subcontractors as required to bring the system into compliance with the design, and the problem shall then be rechecked to verify that the system operates normally. Any remaining difficulties shall be brought to the attention of the Engineer.

E. Do not install equipment, ductwork, piping and conduit which makes rigid contact with the structure unless it is allowed by this Section.

F. The Subcontractor shall bring to the Engineer’s attention prior to installation conflicts which will result in unavoidable contact between the building structure and the isolated equipment, piping, etc., described herein, due to inadequate space, etc. Corrective work necessitated by conflicts after installation shall be at the expense of the Subcontractor.

G. The Subcontractor is to bring to the Engineer’s attention prior to installation discrepancies between the requirements of this Section and field conditions, changes required due to specific equipment selection, etc. Corrective work necessitated by discrepancies after installation is at the expense of the responsible Subcontractor.

H. Resilient Wall, Ceiling, and Floor Penetrations: Provide resilient wall and ceiling penetrations for piping, conduit, ductwork, etc. supported on Type HS of Type FSN isolators. Refer to resilient penetration details on the Drawings.

I. Support vibration isolated ducts, pipes, and equipment directly from structural steel, not the concrete deck.

## 3.02 ISOLATOR INSTALLATION

A. The installation or use of vibration isolators must not cause change of position of equipment, conduit, piping or ducting, which would result in stresses in connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and attached systems in a rigid position during installation, the load shall not be transferred to the isolator until the installation is complete and under full operational load. plumbing, piping, and ducting at mechanical equipment connections is to be fully supported by specified hangers. Mechanical equipment and vibration mounts shall not carry plumbing, piping, or ducting loads. Utilize flexible metal, liquid-tight conduit for electrical connections.

B. Isolation/Absorption Products: The completed installation must be free of vibration and noise. Systems, equipment, or parts which vibrate or generate vibration unduly, or which generate or emit undue noise while in operation shall: 1) be adjusted, repaired or replaced as appropriate to obtain acceptable levels of vibration or noise; or 2) be supported on, or fitted with, suppression or absorption devices or other means, which effectively prevent the transmission of vibration or noise beyond the offending item.

C. Equipment Isolator Installation

1. Use space saver brackets for equipment supported on Type FSN vibration isolators.

2. The minimum operating clearance between the underside of the frame or inertia base and the pad or floor is 1 inch.

3. Place the frame in position and support temporarily by shims prior to the installation of the machine or isolators.

4. After the entire system installation is completed and under full operational load, adjust the isolators so that the load is transferred from the shims to the isolators, and that the shims are barely free. Remove the shims.

5. Seismic snubbers shall not be finally installed until vibration isolators are in-place and adjusted with actual operating loads.

D. Isolator Hangers

1. The isolators shall be installed with the isolator hanger box as close as possible to the structure.

2. The isolators shall be suspended from massive beams, never from slab diaphragms between beams.

3. Orientation of isolator assembly including support and load rods shall be within five degrees of vertical.

## 3.03 EQUIPMENT ISOLATION

A. Install isolators for fans, chillers, compressors, pumps and other such equipment as shown on Vibration Isolation Schedule or as otherwise required.

B. Approve completed vibration isolation system for isolated equipment.

## 3.04 PIPING ISOLATION

A. Where specifically indicated only, use specified pipe isolation system.

## 3.05 VIBRATION ISOLATION SCHEDULE

| Equipment | Base Type and Weight[1] | Isolator Type | Minimum Static Deflector (inches) |
|---|---|---|---|
| Pipes with water pressure | N/A | Acousto-Plumb and insulate pipes at each partition penetration with 1-inch-thick insulation | N/A |

1X = 1 time the weight of the equipment supported.
2X = 2 times the weight of the equipment supported.
N/A = Not applicable

**END OF SECTION**

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# SECTION 21 05 53
# IDENTIFICATION FOR FIRE PROTECTION, MECHANICAL PROCESS, AND LIFE SAFETY SYSTEM EQUIPMENT

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Identify all installed fire protection and mechanical system distribution piping, mechanical equipment, building components, process systems, the fire alarm system, and all associated components and appurtenances thereto in accordance with all applicable codes and standards as listed herein.

C. Related Sections:

1. Division 01 – General Requirements

2. Section 09 90 00 – Painting

3. Section 21 05 00 – Basic Fire Suppression Requirements

4. Section 21 13 13 – Wet Pipe Sprinklers

5. Section 21 13 24 – Fluorine-Free Foam Fire Suppression System

6. Section 28 46 20 – Fire Alarm Systems

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

11-21-2024

2. Unless otherwise noted, the referenced standard edition is the current one at the time of bid opening.

3. Refer to Division 01 – General Requirements for the list of applicable regulatory requirements.

4. Refer to Section 21 05 00 – Basic Fire Suppression Requirements for codes and standards and other general requirements.

B. Standards

1. ASME

a. ASME/ANSI A13.1 – Scheme for the Identification of Piping Systems

2. NFPA

a. NFPA 13 – Standard for the Installation of Sprinkler Systems

b. NFPA 70 – National Electrical Code

c. NFPA 72 – National Fire Alarm and Signaling Code

## 1.03 SUBMITTALS

A. Submit under provisions of Section 21 05 00 – Basic Fire Suppression Requirements, for review of materials, Section 01 33 00 – Submittal Procedures, and Division 01 – General Requirements.

B. Submit list of wording, symbols, letter size, proposed signage, and color coding for identification.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. W. H. Brady or Westline products or equivalent shall be used for pipe labeling.

B. Identification signs for sprinkler system and standpipe components shall be of any type meeting the requirements of NFPA 13, and associated requirements in Section 21 13 13 – Wet Pipe Sprinklers or Section 21 13 24 – Fluorine-Free Foam Fire Suppression System.

C. Identification signs, covers, and nameplates shall be in accordance with Section 28 46 20 – Fire Alarm Systems.

## 2.02 MATERIALS

A. Color Coding: ASME/ANSI A13.1 unless specified otherwise by applicable standards or publications.

B. Plastic Nameplates: laminated two-layer plastic with engraved letters on a contrasting background color as required by ASME/ANSI A13.1.

C. Fire Protection Valve and Trim Signage: Equipment identification signs used for indoor equipment shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18-gauge steel or 0.020-inch aluminum with red letters on a white background or white letters on red background. All text shall be a minimum 1-inch lettering.

D. Fire Alarm System and Device Components: Identify fire alarm equipment devices by means of 3/32-inch-thick red laminated phenolic nameplate with white core. Engrave fire alarm panel identification using a minimum size of 1-inch character height, Helvetica style font. Fire alarm device numbers shall be a minimum of 3/16-inch size, and fire alarm zone numbers shall be 1/4-inch size. Attach nameplates with No. 4-36 RH nickel plated brass machine screws. Device numbers may be adhered with glue or equivalent.

E. Stencils: Where piping is painted rather than provided with labels, paint with clean-cut symbols and letters of following size:

| Outside Diameter of Insulation or Pipe (inches) | Color Field Length (inches) | Letter Height (inches) |
|---|---|---|
| 3/4 to 1-1/4 | 8 | 1/2 |
| 1-1/2 to 2 | 8 | 3/4 |
| 2-1/2 to 6 | 12 | 1-1/4 |
| 8 to 10 | 24 | 2-1/2 |
| Greater than 10 | 32 | 3 |
| Equipment | - | 2-1/2 |

F. Stencil Paint: Semi-gloss enamel; in accordance with Section 09 90 00 – Painting.

G. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

1. Special gases shall be identified using markers with lettering and backgrounds per ASME/ANSI A13.1, provided with a direction arrow, and full chemical names and symbols.

H. Plastic-Tape Pipe Markers: Flexible, vinyl-film tape with pressure-sensitive adhesive backing and printed markings. Color-codings in accordance with ASME/ANSI A13.1

I. Fire Alarm System Covers: Paint all box and conduit body covers red per Section 09 90 00 – Painting.

## PART 3 – EXECUTION

### 3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive of identification materials where provided.

B. Prepare surfaces in accordance with Section 09 90 00 – Painting for stencil painting.

### 3.02 INSTALLATION

A. Plastic Nameplates: Install with corrosion-resistant mechanical fasteners or adhesive.

B. Plastic Tags: Install with corrosion-resistant chain.

C. Stencil Painting: Apply in accordance with Section 09 90 00 – Painting.

D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

E. Plastic-tape Pipe Markers: Install completely around pipe in accordance with manufacturer's instructions.

### 3.03 IDENTIFICATION SCHEDULE

A. Valves: Mark all sprinkler system valves in accordance with NFPA 13, and Section 21 13 13 – Wet Pipe Sprinklers or Section 21 13 24 – Fluorine-Free Foam Fire Suppression System or others as appropriate.

B. Sprinkler Riser Trim: Identify sprinkler riser trim in accordance with NFPA 13, and Section 21 13 13 – Wet Pipe Sprinklers or Section 21 13 24 – Fluorine-Free Foam Fire Suppression System or others as appropriate.

C. Fire Alarm System Nameplates: Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Furnish nameplate illustrations and data to obtain approval by the Owner before installation. Obtain approval by the Owner for installation locations. Nameplates shall be etched metal or

plastic, permanently attached by screws to panels or adjacent walls. Major components include, but are not limited to, the following:

1. Fire Alarm Control Panel/Fire Alarm Control Unit

2. Mass Notification Control Panel

3. Automatic transmitter/transceiver

4. Terminal cabinet

D. Fire Alarm System Initiating Devices and Notification Appliances: Each initiating device and notification appliance, as well as other major components, shall be provided with a unique device address in accordance with this Section and Section 28 46 20 – Fire Alarm Systems.

E. Piping: Identify piping, concealed or exposed, with labels in accordance with Owner's requirements, and ASME/ANSI A13.1. Locate identification not more than 20 feet apart on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, at each obstruction, and within 2 feet of each change of direction in accordance with the following color and marking scheme:

| Classification | Letter/Background Color |
|---|---|
| Fire Quenching Fluids | White/Red |
| Toxic and Corrosive Fluids | Black/Orange |
| Flammable Fluids | Black/Yellow |
| Combustible Fluids | White/Brown |
| Potable, Cooling, Boiler Feed, and Other Water | White/Green |
| Compressed Air | White/Blue |

## 3.04 ADDITIONAL FIRE PROTECTION AND LIFE SAFETY EQUIPMENT IDENTIFICATION

A. Provide identification for all rooms, closets, doorways, or other areas where Fire Alarm Equipment or Fire Protection System Equipment, or Fire Department access or access to equipment is located in accordance with the CBC, CFC, NFPA 13, NFPA 70, and NFPA 72. Areas include, but are not limited to:

1. Thermal Dryer Facility main room

2. Electrical rooms

3. Refrigeration rooms

4. Battery rooms

5. Roof access hatches, doorways, and stairwells leading to roof access

6. Fire lanes

7. Locations of electrical disconnects and disconnect switches

8. Photovoltaic equipment where the energized equipment contains direct current (DC)

9. Fire Department connections

10. Fire Department standpipe connections

B. Provide identification for all process piping, hazardous materials piping, storage, and equipment using liquids or gases in accordance with Owner requirements, ANSI/ASME A13.1, the CFC, the CBC, and NFPA 400. This includes, but is not limited to the following processes, storage, and systems:

1. Gas cylinders in storage regardless of hazard (inert, toxic, corrosive, flammable, oxidizing, combustible, etc.)

2. Flammable and corrosive liquid storage cabinets both free-standing, and when integral to fume hoods or other exhausted enclosures

3. All gas cabinets and exhausted enclosures

C. Wherever charts, Shop Drawings, etc. refer to specific room numbers, use room numbers that will be provided by the Owner rather than the room numbers indicated on the Drawings.

**END OF SECTION**

## SECTION 21 13 13
## WET PIPE SPRINKLERS

### PART 1 – GENERAL

### 1.01 SYSTEM DESCRIPTION

A. This Section describes the provision of a wet pipe sprinkler system.

B. Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage. Provide wet pipe sprinkler system in areas indicated on the Drawings. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on Drawings shall be determined by hydraulic calculation.

C. Design any portions of the sprinkler system that are not indicated on the Drawings including locating sprinklers, piping, and equipment and size piping and equipment when this information is not indicated on the Drawings or specified herein. The design of the sprinkler system shall be based on hydraulic calculations and the other provisions specified herein.

### 1.02 REFERENCES

A. The following publications form a part of this Section to the extent referenced. The publications are referred to within the text by the basic designation only. The edition of each reference that is effective of the date of Bid shall apply to this Section. Where this Section conflicts with the following references, DOE Order 420.1C and DOE Standard 1066 shall govern.

1. ASSE

    a. ASSE 1015 – Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

2. AWWA

    a. AWWA C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

    b. AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

    c. AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast, for Water

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d. AWWA C203 – Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

e. AWWA C606 – Grooved and Shouldered Joints

3. ASME

a. ASME B16.1 – Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

b. ASME B16.3 – Malleable Iron Threaded Fittings, Classes 150 and 300

c. ASME B16.4 – Standard for Gray Iron Threaded Fittings; Classes 125 and 250

d. ASME B16.9 – Standard for Factory-Made Wrought Steel Buttwelding Fittings

e. ASME B16.11 – Forged Fittings, Socket-Welding and Threaded

f. ASME B18.2.2 – Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

4. ASTM

a. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

b. ASTM A135/A135M – Standard Specification for Electric-Resistance-Welded Steel Pipe

c. ASTM A183 – Standard Specification for Carbon Steel Track Bolts and Nuts

d. ASTM A536 – Standard Specification for Ductile Iron Castings

e. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts

f. ASTM A795/A795M – Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

5. FM

a. FM Approval Guide (http://www.approvalguide.com)

6. MSS

a. MSS SP-71 – Gray Iron Swing Check Valves, Flanged and Threaded Ends

7. NFPA

    a. NFPA 13 – Standard for the Installation of Sprinkler Systems

    b. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances

    c. NFPA 101 – Life Safety Code

    d. NFPA 1963 – Standard for Fire Hose Connections

    e. NFPA 291 – Recommended Practice for Fire Testing Fire Flows and Hydrant Marking

8. USDOE

    a. DOE-O-420.1c – Facility Safety

    b. DOE-STD-1066 – Fire Protection

9. UL

    a. UL 668 – Hose Valves for Fire-Protection Service

    b. UL Building Materials Directory

10. UL Fire Protection Equipment Directory

B. Refer to General Conditions, Supplementary Conditions, and Division 01 – General Requirements for a list of applicable regulatory requirements where not included as follows. Refer to Section 21 05 00 – Basic Fire Suppression Requirements for codes and standards and other requirements.

## 1.03 RELATED SECTIONS

A. Section 21 05 53 – Identification for Fire Protection, Mechanical Process, and Life Safety System Equipment

B. Section 28 46 20 – Fire Alarm Systems

C. Section 31 00 01 – Earthwork

## 1.04 DESIGN PARAMETERS

A. Hydraulic Design

1. All general laboratory and office areas are to be designed at a minimum to protect an NFPA 13 defined, Ordinary Hazard, Group 1 occupancy in accordance with

DOE Standard 1066. Where required to match additional hazards (e.g. Hazardous Materials, Storage, etc.), the design and installation shall be compliant with NFPA 13 and all applicable codes pursuant to the hazard being protected. Do not design the sprinkler system to a Light Hazard Occupancy classification, unless directed by the Fire Marshal.

2. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 feet/second.

3. Hose Demand

    a. Add an allowance for interior and exterior hose streams as required by applicable NFPA standard.

4. Basis for Calculations

    a. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping. Per DOE Standard 1066, all hydraulically designed sprinkler systems shall be designed for a supply pressure of at least 10 percent, but not less than 10 psi, below the water supply curve to provide a pressure margin to accommodate minor system modifications or degradation of the water supply and sprinkler systems that may occur over time. All water testing for the design of sprinkler systems shall be conducted in accordance with NFPA 291.

5. Hydraulic Calculations

    a. Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments and as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the Drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the Drawings to substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe. For gridded systems, calculations shall

show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

B. Sprinkler Coverage

1. Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 100 square feet for extra hazard occupancies, and 130 square feet for ordinary hazard occupancies.

2. Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101, where this omission does not conflict with NFPA 13.

## 1.05 SUBMITTALS

A. Fire Marshal approval is required for all fire protection equipment submittals. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Drawings

a. Shop Drawings

b. As-Built Drawings (Closeout Submittal)

2. Product Data

a. Fire Protection Related Submittals

b. Materials and Equipment

c. Spare Parts

3. Design Data

a. Sway Bracing Layout and Calculations (static and dynamic loads)

b. Hydraulic Calculations

4. Test Reports

    a. Preliminary Test Report

    b. Final Acceptance Test Report

5. Certificates

    a. Inspection by Fire Protection Engineer

6. Operation and Maintenance Data

    a. Operating and Maintenance Manuals

## 1.06 QUALITY ASSURANCE

A. Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Fire Marshal.

B. Fire Protection Engineer

1. Installations needing designs or modifications of fire detection, fire alarm, or fire suppression systems require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as a registered Professional Engineer in the state of Georgia for fire protection engineering.

C. Sprinkler System Installer and Welder

1. Submit evidence that the installer is regularly engaged in the installation of automatic fire sprinkler equipment and systems with at least 3 years of experience, and that they are licensed by the state of Georgia to perform such construction. Submit evidence that the welder(s) for this Project are certified in accordance with ASME BPVC Sec IX or AWS D10.9. Submit the name and documentation of certification of the proposed Sprinkler System Installer and Welder, concurrent with submittal of the fire protection engineer qualifications.

D. Shop Drawings

1. Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views

demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" and provided in ANSI size “D” sheets.

c. Submit floor plans which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

d. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

e. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

f. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. Submit load calculations for sizing of sway bracing, for systems that are required to be protected against damage from earthquakes.

g. The drawings shall be sequenced in a logical order, such as building and floor numbers in ascending order. With the exception of common construction details, each drawing shall depict work within a single building.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

## 1.08 EXTRA MATERIALS

A. Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

# PART 2 – PRODUCTS

## 2.01 STANDARD PRODUCTS

A. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

## 2.02 NAMEPLATES

A. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

## 2.03 REQUIREMENTS FOR FIRE PROTECTION SERVICE

A. Provide Materials and Equipment that have been tested by UL and are listed in UL Fire Protection Equipment Directory or approved by FM and listed in FM Approval Guide. Where the terms "listed" or "approved" appear in this Section, such shall mean listed in UL Fire Protection Equipment Directory or FM Approval Guide. Submit manufacturer's catalog data included with the sprinkler system Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

## 2.04 UNDERGROUND PIPING COMPONENTS

A. Pipe

1. Piping from a point 12 inches above the floor to a point 5 feet outside the building wall shall be ductile iron with a rated working pressure of 175 psi conforming to AWWA C151/A21.51, with cement mortar lining conforming to AWWA C104/A21.4. Piping more than 5 feet outside the building walls shall comply with Section 22 11 13 – Facility Water Distribution Piping.

B. Fittings and Gaskets

1. Fittings shall be ductile iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

C. Gate Valve and Indicator Posts

1. Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Protection Equipment Directory or FM Approval Guide.

## 2.05 ABOVEGROUND PIPING COMPONENTS

A. Aboveground piping shall be steel.

B. Steel Piping Components

1. Steel Pipe

a. Except as modified herein, steel pipe shall be Schedule 40 black steel for all piping 6 inches in diameter and smaller, Schedule 30 for steel pipe greater than 6 inches in diameter, and shall conform to applicable provisions of ASTM A795/A795M, ASTM A53/A53M, or ASTM A135/A135M. Pipe in which threads or grooves are cut or rolled formed shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut or rolled formed. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2. Fittings for Non-Grooved Steel Pipe

a. Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

3. Grooved Mechanical Joints and Fittings

a. Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings

shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

4. Flanges

a. Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

C. Pipe Hangers and Sway Bracing

1. Hangers and braces shall be listed in UL Fire Protection Equipment Directory or FM Approval Guide and of the type suitable for the application, construction, and pipe type and sized to be supported and braced.

D. Valves

1. Control Valve and Gate Valve

a. Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Building Materials Directory or FM Approval Guide.

2. Check Valve

a. Check valve 2 inches and larger shall be listed in UL Building Materials Directory or FM Approval Guide. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

3. Hose Valve

a. Valve shall comply with UL 668 and shall have a minimum rating of 300 psi. Valve shall be non-rising stem, all bronze, 90-degree angle type, with 2-1/2-inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 2-1/2 to 1-1/2-inch reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Contractor shall confirm the proper hose threads with Owner prior to purchasing or installing any equipment. Valve finish shall be rough chrome plated.

## 2.06 WATERFLOW ALARM

A. Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13 on an exterior wall in a location to provide maximal notification. Waterflow alarm bell shall be rated 24VDC and shall be connected to the Fire Alarm Control Panel (FACP). Provide a visible notification appliance (strobe), listed for exterior service, rated for a minimum 110 candela, installed in accordance with Section 28 46 20 – Fire Alarm Systems.

## 2.07 ALARM INITIATING AND SUPERVISORY DEVICES

A. Sprinkler Waterflow Indicator Switch, Vane Type

1. Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper-resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

B. Sprinkler Pressure (Waterflow) Alarm Switch

1. Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2-inch NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

C. Valve Supervisory (Tamper) Switch

1. Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.08 FIRE DEPARTMENT CONNECTION

A. Fire department connection shall be projecting-type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a chromium plated finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963. Where required to meet hydraulic needs of the

sprinkler system and standpipe system, a minimum 4-inch connection may be provided in addition to the 2-1/2-inch connections. Contractor shall verify thread type with Owner before purchasing equipment.

## 2.09 SPRINKLERS

A. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be as required for the occupancy protected, in accordance with NFPA 13. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

B. Pendent Sprinkler

1. Pendent sprinkler shall be of the fusible strut or glass bulb type, quick response type with nominal 1/2 inch orifice. Pendent sprinklers shall have a polished chrome finish.

C. Upright Sprinkler

1. Upright sprinkler shall be chrome-plated quick-response type and shall have a nominal 1/2-inch or 17/32-inch orifice.

D. Sidewall Sprinkler

1. Sidewall sprinkler shall have a nominal 1/2-inch orifice. Sidewall sprinkler shall have a polished chrome finish. Sidewall sprinkler shall be the quick-response type.

E. Corrosion Resistant Sprinkler

1. Corrosion-resistant sprinkler shall be the upright type installed in locations as indicated. Corrosion-resistant coatings shall be factory-applied by the sprinkler manufacturer.

## 2.10 ACCESSORIES

A. Sprinkler Cabinet

1. Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided. Mount sprinkler cabinet adjacent to the fire sprinkler riser, in a readily accessible location. Mount the cabinet so the top of the cabinet is 5 feet above finished floor.

B. Pendent Sprinkler Escutcheon

1. Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

C. Pipe Escutcheon

1. Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

D. Sprinkler Guard

1. Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located in areas where they are subject to mechanical damage.

E. Identification Sign

1. Equipment identification signs used for indoor equipment shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18-gauge steel or 0.020-inch aluminum with red letters on a white background or white letters on red background. All text shall be a minimum 1-inch lettering.

2. Signs for outdoor equipment such as PIVs, wall PIVs, FDC signs, sprinkler riser rooms, etc., shall be plastic and resistant to ultraviolet light with white letters on a red background.

3. All writing on signs shall be in CAPITAL LETTERS.

4. Wording of signs shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm line," “alarm test,” “control valve,” and similar wording as required for identification of operational components.

5. All sprinkler system identification signs shall read: “Fire Sprinkler System XX” where “XX” is the name of the system.

6. Valve signs shall indicate which system or systems are controlled by the valve. FDC signs shall indicate the building(s) supplied by the FDC.

7. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

F. Water Pressure Gauges

1. Gauges shall be UL Listed and FM Approved for Fire Protection Service. Gauges shall have a 1/4-inch NPT connection. Water pressure gauges shall have a working pressure of 175 psi, and a maximum pressure of 300 psi.

2. Each gauge shall have its installation date written legibly on the gauge, in either permanent marker or paint pen. The color of the date shall contrast with the surface of the gauge with the date on it. The location of the written date shall not interfere with reading the pressure on the gauge. Date format shall be MM/YYYY.

G. Control Valve Locks and Chain

1. Contractor shall provide breakaway locks approved by the Cherokee County Fire Department, and keyed alike.

2. Locks for control valves that are not PIVs shall also be accompanied by a chain of sufficient length to lock the valve handle and deter tampering. For valves 2-1/2 inches and larger, the chain shall be metallic and a minimum 1/4 inch thick. For valves smaller than 2-1/2 inches, provide chain or cable sized to permit locking of the valve.

## 2.11 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

A. Double-check detector assembly (DCDA) backflow prevention assembly shall comply with ASSE 1015 and shall be Watts Model 757DCDA or LF856.

B. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, two positive-seating check valves for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 175 psi. The maximum pressure loss shall be 6 psi at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

# PART 3 – EXECUTION

## 3.01 FIELD MEASUREMENTS

A. After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Engineer of any discrepancy before performing the work.

## 3.02 INSTALLATION REQUIREMENTS

A. The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.

## 3.03 INSPECTION BY FIRE PROTECTION SUBCONTRACTOR

A. Prior to ceiling installation and concurrent with the Final Acceptance Test Report, certification by the Fire Protection Subcontractor that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. The Fire Protection Subcontractor shall: 1) inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the Contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Engineer in writing, no later than 3 working days after the discrepancy is discovered.

## 3.04 ABOVEGROUND PIPING INSTALLATION

A. Protection of Piping Against Earthquake Damage

1. Seismically protect the system piping against damage from earthquakes in accordance with NFPA 13. Provide zone of influence calculations for all bracing configurations that include both static and dynamic loading.

B. Piping in Exposed Areas

1. Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

C. Piping in Finished Areas

1. In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

D. Pendent Sprinklers

1. Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches for steel pipe. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed

such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

E. Upright Sprinklers

1. Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

F. Flexible Sprinkler Piping

1. Where flexible sprinkler piping is used to supply pendent sprinklers in ceiling grids, ductwork or other areas, install the flexible sprinkler piping in accordance with the manufacturer’s specifications. Do not exceed the minimum bend radius, or maximum number of bends as published by the manufacturer’s listing and approvals. Where flexible sprinkler piping is installed in hard ceilings and not listed for such installation, provide a manufacturer’s detail or engineering detail substantiating the installation.

G. Pipe Joints

1. Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the Project Site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer.

H. Reducers

1. Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

I. Pipe Penetrations

1. Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be

Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with a UL Listed firestopping assembly to match the fire resistance rating of the assembly penetrated and approved by the Fire Marshal. For penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

J. Escutcheons

1. Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

K. Inspector's Test Connection

1. Unless otherwise indicated, test connection shall consist of 1-inch pipe connected to the remote branch line, a test valve located approximately 7 feet above the floor, a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system, and a painted metal identification sign affixed to the valve with the words "Inspector's Test Connection." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge. Discharge must be to landscaping or sanitary sewer only. Combination test-and-drain equipment may be used where listed for such service.

L. Drains

1. Main drain piping shall be provided to discharge into landscaping or sanitary sewer. Auxiliary drains shall be provided as required by NFPA 13. Combination test-and-drain equipment may be used where listed for such service.

M. Installation of Fire Department Connection

1. Connection shall be mounted in a location approved by the Fire Marshal. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

N. Identification Signs

1. Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by

NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

## 3.05 UNDERGROUND PIPING INSTALLATION

A. General

1. The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 12 inches above the finished floor.

B. Protection from Foreign Material

1. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. All underground piping shall be flushed in accordance with NFPA 24 prior to placing any sprinkler systems into service.

2. Protect adjacent buildings and stored commodities from water damage when performing flush test.

C. Pipe Restraint

1. Joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Buried nuts, bolts etc. shall be provided with a corrosion resistant mastic in accordance with NFPA 24. All buried steel fittings, including “T” fittings, elbows, 90-degree fittings, four-way intersections, etc. shall be provided with a plastic wrap to prevent corrosion.

2. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. Bearing face calculations for thrust blocks shall be prepared and submitted for approval, including height, depth, and width of the thrust blocks. In addition, if a joint restraint system is used joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Protect all steel rods from corrosion with a mastic coating.

D. Backfilling

1. Backfilling shall be provided in accordance with NFPA 13 and NFPA 24. All joints and piping shall be left exposed for inspection by the Engineer and Fire Marshal prior to covering. Covering underground piping before inspection and approval by the Fire Marshal will require the piping to be uncovered and inspected at no

expense to the Owner. Unless otherwise required, all joints shall be backfilled prior to hydrostatic testing.

## 3.06 ELECTRICAL WORK

A. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 46 20 – Fire Alarm System. Wiring color code shall remain uniform throughout the system.

## 3.07 PIPE COLOR CODE MARKING

A. Color code mark piping as specified in Section 09 90 00 – Painting. All sprinkler pipe shall be properly primed for painting and finished with a red color coating. All new fire protection supply piping 2 inches and greater shall be labeled every 25 feet in length, in accordance with the Owner's standards and ANSI A13.1. Labels shall be a minimum of 2 inches wide, with white lettering on red background that state "Fire Protection Water." Where piping can have multiple flow directions (i.e. a gridded system), directional marking is not required.

## 3.08 PRELIMINARY TESTS

A. The system, including the underground water mains, and the aboveground piping and system components, shall be inspected and tested to ensure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, submit three copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Subcontractor.

B. Underground Piping

1. Flushing

a. Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

2. Hydrostatic Testing

a. Underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints

shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

C. Aboveground Piping

1. Inspection and Testing Preparation

a. After the system has been installed per approved submittals, confirm that all suspended ceilings are removed or provide visible access to all piping above the ceilings. All work from other trades has been completed (e.g. framing, electrical, painting, plumbing, mechanical, etc.), and follow-up work will not impact the installation of the sprinkler system. Contractor shall provide approved plans for review during the inspection and testing.

2. Hydrostatic Testing

a. Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi, or 50 psi in excess of maximum system operating pressure where operating pressure is greater than 150 psi, and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3. Backflow Prevention Assembly Forward Flow Test

a. Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. Provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5-inch-diameter hoses, playpipe nozzles, calibrated pressure gauges, pitot tube gauge, plus all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. Provide a metal placard on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

D. Testing of Alarm Devices

1. Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm device shall be tested to verify proper operation.

E. Main Drain Flow Test

1. Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded and submitted to the Owner. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

## 3.09 FINAL ACCEPTANCE TEST

A. Begin the Final Acceptance Test only when the Preliminary Test Report has been approved. Submit proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests, and proposed date and time to begin the Test, submitted with the procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates. The Fire Protection Subcontractor shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Submit as-built shop drawings, no later than 14 days after completion of the Final Tests, updated to reflect as-built conditions after all related work is completed. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. Submit three copies of the completed Final Acceptance Test Report no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Subcontractor.

## 3.10 ON-SITE TRAINING

A. The Fire Protection Subcontractor shall conduct a training course for operating and maintenance personnel as designated by the Engineer. Submit proposed schedule, lesson plan, materials, etc. as specified in Section 01 79 00 – Instruction of Owner’s Personnel. Training shall be provided for a period of time as specified in Section 01 79 00 – Instruction of Owner’s Personnel and shall start after the system is functionally complete and after the Final Acceptance Test. Submit Operating and Maintenance Manuals as specified in Section 01 78 23 – Operation and Maintenance Data prior to training. The on-site training shall cover all of the items contained in the approved manuals.

**END OF SECTION**

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## SECTION 21 13 24

## FLUORINE-FREE FOAM FIRE SUPPRESSION SYSTEM

### PART 1 - GENERAL

### 1.01 WORK INCLUDED

A. This Section describes the design and provision of the new Fluorine-Free Foam Fire Suppression System for the Thermal Fluid Heater Room. The design flow rate shall be based on the information indicated on the Drawings and in this Section. The fire protection system shall be in accordance with NFPA 11, NFPA 13, NFPA 16, and as required by the Owner's insurance carrier and the local fire protection authority having jurisdiction. The Contractor is responsible for designing, furnishing, and installing all fire protection services, including but not limited to, piping, wiring, equipment and devices as required for a complete, approved, and functioning system.

B. The Contractor shall provide a deluge, foam-water, fire sprinkler system for the Thermal Fluid Heater Room. Include all detectors, switches, alarms, wiring, and controls.

C. The Contractor shall hydraulically calculate and size all fire protection equipment, piping and devices to ensure adequate flow to all system components. The Contractor shall use the latest flow test data available from the Owner to use as the basis of the hydraulic calculations.

### 1.02 RELATED WORK

A. Drawings and general provisions of Contract, including General Conditions and Supplementary Conditions and Specification Sections, apply to work of this Section. The Drawings describe the fire protection requirements. The Contractor shall coordinate with other trades' drawings and contractors.

B. Division 01 – General Requirements

C. Division 21 – Fire Suppression

D. Division 26 – Electrical

### 1.03 SYSTEM DESCRIPTION

A. Design Reliability

1. The designer of the fire protection systems shall meet one of the following requirements:

a. A registered Professional Engineer.

b. National Institute for Certification in Engineering Technologies (NICET) Level III in Automatic Sprinkler Layout. Copies of the designer's certificate from NICET shall be submitted along with the drawings for approval.

c. The Contractor is responsible for the design and installation of the fire protection system, including supports, in accordance with the Specifications and Drawings. The Contractor shall coordinate the fire protection system design with the requirements of the architectural, civil, mechanical, and electrical portions of the Contract Documents to ascertain the required information to ensure a properly designed fire protection system for the building construction and occupancy classification.

B. Codes and Standards

1. The Contractor shall install the fire protection systems in accordance with the latest editions of the following Standards:

a. NFPA 11 – Standard for Low-, Medium-, High-Expansion Foam

b. NFPA 13 – Installation of Sprinkler Systems

c. NFPA 16 – Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

d. NFPA 70 – National Electric Code

e. NFPA 72 – National Fire Alarm Code

f. NFPA 101 – Life Safety Code

2. NEMA IA 10030 – Industrial Control And Systems: Enclosures

3. UL Fire Protection Equipment Directory

4. FM Global requirements, if applicable to this Project

C. Materials and Equipment

1. All equipment and devices shall be of a make and type listed by UL and/or approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used.

2. The Contractor shall provide fire protection products in accordance with UL standards and shall provide UL Label on each product.

3. If applicable to this Project, Contractor shall provide fire protection products and installations in accordance with FM standards.

4. All products shall be listed for fire protection service.

5. The fire protection systems shall be in conformance with all Federal, State, and Local requirements.

## 1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including type, model, and physical dimensions.

C. All literature and instructions provided by the manufacturer of all installed equipment and devices describing proper operation, maintenance, and safety concerns.

D. Piping layout drawings, electrical interface schematics, and hydraulic calculations. Hydraulic calculations and Contract Drawings shall be submitted to, and approved by, the Owner's insurance carrier and the local fire protection authority prior to installation.

E. Contractor shall provide certification indicating that the system is installed in compliance with the applicable codes.

F. Contractor shall provide verification that the appropriate acceptance tests have been conducted in accordance with the local fire protection authority and the applicable codes.

## 1.05 CONDUIT

A. Conduit shall be in accordance with the NEC and local and state requirements. Refer to Section 26 05 33.13 – Conduit for Electrical Systems.

B. Conduit shall not exceed 40 percent of interior cross-sectional area where three or more cables are contained within a single conduit.

C. Cable must be separated from any open conductors of power or Class 1 circuits and shall not be placed in any conduit, junction box, or raceway containing these conductors, as per NEC Article 760-29.

## 1.06 WIRE

A. All fire alarm system wiring shall be new.

B. Wiring shall be in accordance with local, state, and national codes (e.g., NEC Article 760). Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits. Refer to Section 26 05 19 – Low-Voltage Conductors and Cables.

C. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling (fire alarm) system.

## 1.07 DELUGE FOAM-WATER SPRINKLER SYSTEM DESIGN CRITERIA

A. Provide a deluge, foam-water fire protection system for the Extra Hazard areas as shown on Drawings.

B. The system shall include all accessories as are necessary for a complete and operational system. The foam-water system shall include but not be limited to the foam concentrate, foam bladder tank, foam proportioner, fire cross main, deluge valve, control panel(s), associated wiring, sprinkler piping and heads, and all accessories necessary for a complete and operational system.

C. Design of the foam-water system shall be by hydraulic calculations for uniform distribution of foam solution over the protected area and shall conform to the NFPA standards and the requirements specified herein.

D. Foam Concentrate

1. The foam concentrate shall be UL Listed and/or FM Approved for use on hydrocarbon fuels.

2. Foam concentrate shall be ANSULITE® 3x3 Low Viscosity Alcohol-Resistant AR-FFF Concentrate.

E. Distribution of Foam Solution: Distribution shall be essentially uniform throughout the area. Variation in discharge from individual sprinkler heads shall be between 100 and 120 percent of the specified density.

1. Duration of Foam Discharge

a. System shall apply 3% foam solution over the sprinkler discharge area for a minimum of 10 minutes.

2. Sprinkler Discharge Area

a. Area shall be based on the entire protected space as defined by the drainage area or specified by the authority having jurisdiction (AHJ).

3. Solution Application Density

a. The Contractor shall size the system to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinkler system shall be a minimum of 0.16 gpm/square foot for hydrocarbon fuels.

b. The hydraulic calculations shall include an allowance for a 500 gpm (1892 Lpm) outside water hose stream.

4. Friction Losses

a. Calculated losses in pipe shall be in accordance with the Hazen-Williams formula with “C” value of 120 for galvanized steel pipe.

5. Location of Sprinkler Heads

a. The quantity and location of the new sprinkler heads [and nozzles] serving the Thermal Fluid Heater Room shall be in accordance with the Drawings. Sprinklers shall be listed/approved with the manufacturer of the foam utilized.

b. Locations of sprinklers in relation to the ceiling and spacing of sprinkler heads shall conform to NFPA 13 for extra hazard occupancy. The spacing of sprinklers on the branch lines shall be essentially uniform.

6. Drainage

a. Each sprinkler riser shall be arranged so that it can be drained entirely through the main drain.

## 1.08 ACTIVATION

A. The foam fire protection sprinkler system shall be automatically activated when one or more fire detectors activate.

B. Upon activation of any detector the following shall immediately occur:

1. Activation of the deluge valve to send foam solution to the sprinkler head(s).

2. An alarm shall be sent to the local fire alarm system.

3. Audible and visual alarms shall sound and light locally and on the foam fire protection system control panel.

# PART 2 - PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. ANSUL (a brand of Johnson Controls)

B. CHEMGUARD (a brand of Johnson Controls)

C. TYCO (a brand of Johnson Controls)

D. Proposed substitutions of other manufacturers not listed in this Section must comply with provisions of Section 01 25 00 – Substitution Procedures. Contractor must submit a Substitution Request Form. All substitutions must be pre-approved.

1. All equipment and components shall be new and the manufacturer's current model.

2. All equipment and components shall be installed in strict compliance with manufacturer's requirements.

3. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

4. Sprinkler heads shall be standard pendent or upright type in all spaces except that sprinkler heads under grating, pipe racks, equipment, etc. shall be modified with splash guards to maintain their operating integrity.

## 2.02 DELUGE VALVES

A. Valves shall be operated by a detection and control system listed for the releasing service. The deluge valve shall be provided with electrical solenoids compatible with the voltage and current supplied by the control panel. If 6-inch valves are used in larger risers, provide smoothly tapered fittings. In addition to the automatic operation, arrange each valve for manual hydraulic release at the valve. Provide pressure gauges and the other appurtenances at the deluge valve. The deluge valve shall be TYCO Model DV-5 with associated trim or approved equal. Where system pressures could exceed listed operating pressures, the TYCO Pressure Regulating Model DV-5 Deluge Valve shall be used.

## 2.03 FOAM CONCENTRATE INJECTION

A. The foam proportioner(s) shall be a modified venturi-type designed to accurately proportion and control the mixing of pressurized foam concentrate into the water system. The proportioner(s) shall have either NPT threaded (2-inch and 2-1/2-inch sizes) or "between flange" type (3-, 4-, 6-, and 8-inch sizes) designed to fit between two 150-lb pipe flanges. Proportioner(s) shall be sized for the specified flow rate(s) and either be UL Listed and/or FM Approved with the type of foam concentrate and bladder tank(s) being used in the system. A fixed metering orifice, secured with a stainless steel retaining ring, shall be sized according to the type and percentage of foam concentrate used.

## 2.04 HYDRAULIC CONCENTRATE CONTROL VALVE

A. The hydraulic concentrate control valve shall be a UL Listed and/or FM Approved assembly that is factory assembled and tested. It shall include a threaded bronze body ball valve with mounting kit for securely attaching the hydraulic actuator to ball valve.

The ball valve shall be designed for a minimum 400 psi (27.6 bar) WOG. The valve shall be fitted with a stainless steel ball, stem, and packing nut. Valve seats shall be of glass reinforced Teflon material. The stainless steel hydraulic actuator must be approved by the manufacturer for using water as the medium to operate the actuator. The actuator shall have a position indicator and have the capability for manual override. The actuator shall be designed to operate the valve with a minimum of 30 psi (2.1 bar) water pressure and shall contain no external moving parts which could cause fouling of adjacent equipment, injury to personnel, misalignment problems common to external linkage systems, or potential for disengagement caused by tampering.

## 2.05 FOAM CONCENTRATE

A. The foam concentrate shall be Greenfire Concentrate for hydrocarbons and polar solvents or equal.

## 2.06 FOAM SYSTEM BLADDER TANKS

A. Tanks shall be vertical cylindrical steel ASME-coded pressure rated vessel with a UL Listed and/or FM Approved bladder shaped to conform to the inner pressure vessel configuration. Tanks shall be designed for a working pressure of 175 psi (12.1 bar) and hydrostatically tested to at least 255 psi (17.6 bar). The tank interior shall be coated with a high build epoxy sealer for additional corrosion resistance. The bladder tanks shall be UL Listed and/or FM Approved, together with the type of concentrate and proportioner being used in the system. The bladder tank shall be complete with all necessary outlets and supports such as a two welded saddles for horizontal bladder tanks or four welded legs for vertical bladder tanks. Associated trim on the bladder tank shall include bronze pipe and fittings, four bronze ball valves, minimum of 1”, for concentrate and water vents and drains with secured nameplate depicting the valve name and operating position, and a clear PVC sight gauge. The bladder tank shall have adequate capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total discharge flow. The tank exterior shall be primed and painted red enamel. The bladder tank, proportioner, and foam concentrate shall be the product of a single manufacturer.

## 2.07 UNDERGROUND PIPING AND FITTINGS

A. Buried piping for wet sprinkler systems shall be ductile iron conforming to AWWA C151/A21.51, working pressure not less than 150 psi, with mortar cement lining conforming to AWWA C104/A21.2 for piping under the building to a point 5 feet outside the building walls.

B. Fittings shall be ductile iron, AWWA C110/A21.10. with mechanical joints. Pipe and fittings shall be in accordance with NFPA 13. Mechanical joints shall be UL Listed and/or FM Approved.

## 2.08 ABOVE GRADE PIPING AND FITTINGS

A. Piping for wet sprinkler systems shall be carbon steel ASTM A795 or ASTM A53.

B. Piping 6 inches and smaller shall be Schedule 40. Mark pipe as to the brand or name of the manufacturer, kind of pipe and the ASTM designation in accordance with the “Product Marking” provisions of the ASTM standard.

C. Grooved Fittings and Couplings

1. Provide grooved fittings, couplings, gaskets and bolts by the same manufacturer.

2. Provide malleable iron fittings and couplings complying with ASTM A47 or ductile iron complying with ASTM A536.

3. Provide rigid type couplings except provide flexible type where flexible joints are specifically required by NFPA 13.

4. Ensure coupling gaskets are Grade E (EPDM) approved for dry pipe fire protection service.

5. Provide flush type gasket that fills the entire cavity between the coupling and the pipe.

6. Provide heat treated, cadmium plated or zinc electroplated steel nuts and bolts conforming to ASTM A813.

D. Non-Grooved Fittings

1. Fittings shall be malleable iron, ASTM A197, ANSI B16.3 threaded, ASTM A34, or ANSI 16.9, butt weld.

2. Pipe and fittings shall be in accordance with NFPA 13.

3. Mechanical joints shall be UL Listed and/or FM Approved.

E. Flanges and Gaskets

1. Provide flanges conforming to NFPA 13 and ASME B16.1 that are welded or threaded to the pipe.

2. Provide gaskets that are full face type EPDM or other approved material.

F. Pipe Hangers

1. Provide hangers listed in UL Fire Protection Directory or FM Application Guide and suitable for the application, construction and size of pipe involved.

G. Control Valve

1. Unless otherwise indicated, valves shall be indicating type in accordance with NFPA 13.

2. Valves NPS 2-1/2-inch or larger shall be flanged outside screw and yoke type.

H. Check Valve

1. Check valves 4 inches and larger shall be flanged, swing type, cast or ductile iron body and cover, cast or ductile iron clapper with replaceable EPDM rubber facing.

2. Provide valves that are suitable for either vertical or horizontal mounting and equipped with a removable handhole cover.

3. Indicate direction of flow by an arrow cast in the valve body.

4. Include a plugged pipe threaded connection for a NPS 2-inch drain.

## 2.09 ABOVEGROUND PIPING FOR FFF CONCENTRATE

A. Provide standard weight stainless steel pipe conforming to ASTM A312, Grade TP 304L.

B. Fittings

1. Provide seamless socket weld or flanged fittings conforming to ASTM A403, Grade WP 304L and compatible with the pipe.

2. Grooved type fittings and couplings shall be Type 316 stainless steel conforming to ASTM A5351.

C. Pipe Hangers

1. Provide hangers listed in UL Fire Protection Directory or FM Application Guide and suitable for the application, construction and size of pipe involved.

D. Control Valve

1. Provide indicating type valve with full port ball and operating handle that indicates the Open/Close position of the valve.

2. Provide socket weld or flanged type valve.

3. Valve body and ball shall be Type 316 stainless steel complying with ASTM A351.

4. Valve handle shall have a suitable and substantial means for securing the valve open with a key operated locking device.

E. Alarm Check Valve Assembly

1. Variable pressure type alarm check valve assembly rated for a working pressure of 175 psi.

2. Assembly shall include the standard trim, pressure gauges, retarding chamber, alarm line vent, testing bypass, necessary pipe, fittings and accessories required for a complete installation.

3. Trim valve piping shall be brass.

4. Provide a provision for installing an alarm pressure switch in a non-interruptible arrangement whereby shut off of other alarm devices will not shut off the switch in the non-interruptible location.

F. Automatic Water Control Deluge Valve

1. Electrically actuated type water control valve rated for a maximum working pressure of 175 psi that is resettable without opening the valve and without the use of special tools.

2. Electrical solenoid valve used to activate the water control valve shall be an integral component of the valve or approved for use by the water control valve manufacturer and the control panel manufacturer.

3. Solenoid valve shall be normally closed, de-energized type which opens when energized upon receipt of an electric signal from the control panel.

4. Solenoid valves shall be diaphragm type rated for the maximum pressure of the valve.

5. Water control valves shall be equipped with a means to prevent the valve from returning to the closed position until being manually reset.

6. Provide a complete assembly with the valve manufacturer’s standard trim piping, drain and test valves, pressure gauges, and other appurtenances.

7. Valve shall have an emergency release device for manually tripping the water control valve in the event of a power or other system failure. Device shall be a standard accessory component of the valve manufacturer and labeled as to its function and method of operation.

8. Valves in hazardous locations shall be rated for the area classification.

G. Mechanical Alarm Device

1. Provide a water powered device including body housing, impeller wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation.

H. Fire Department Connection

1. Provide a projecting wall type connection with cast brass body, a chrome plate finish and matching wall escutcheon lettered “Auto Sprinkler”.

2. Connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains.

3. Provide female inlets with NPS 2-1/2-inch American National Fire Hose Connection Screw Threads in accordance with NFPA 1963.

I. Basket Strainer

1. Strainer shall have a cast iron body and cover flanges.

2. Strainer basket shall be perforated brass or stainless steel sheet with 1/4-inch perforations, strainer size shall be 20 mesh and a maximum friction loss of 1 psig at 45 gallons per minimum.

3. Strainer shall be located to allow access to the strainer basket by removing the flange on the top of the strainer.

## 2.10 DISCHARGE DEVICES

A. Sprinklers

1. Sprinklers shall be 1/2-inch orifice spray type.

2. For deluge system sprinklers, provide open type sprinkler without heat responsive and actuating elements.

3. Provide spare sprinklers in accordance with NFPA 13 housed in a metal or plastic container.

B. Fixed Nozzle

1. Fixed nozzles shall be fixed constant flow type, cast brass construction NPS 1-1/2-inch male, suitable for use with FFF solution.

2. Factory set nozzle for required discharge characteristic.

3. Indicated discharge characteristics or K factors on the Drawings.

4. Nozzle discharge pattern shall be field adjustable and lockable.

C. Oscillating Monitor Nozzle Assembly

1. Water-powered monitor assembly shall be FM approved and listed.

2. Water-powered oscillator, monitor, nozzle and related ancillary components to be the product of the same manufacturer.

3. Water-powered oscillating mechanism shall be protected by a strainer.

4. Mechanism shall have a test connection for operating the oscillator from an auxiliary water source without requiring discharge through the nozzle.

5. Mechanism shall have an adjustable elevation angle from 20 degrees below to 60 degrees above horizontal.

6. Oscillation arc shall be adjustable from 10 degrees to 165 degrees and an adjustable speed from 0 degrees to 30 degrees per second.

7. Components in contact with the FFF solution shall be compatible with the foam concentrate and metallic components shall be brass, bronze or stainless steel.

D. Diaphragm Tank Balanced Pressure Proportioning System

1. Tank shall be a steel pressure vessel constructed in accordance with ASME BPVC Section VIII D1. Affix an ASME label permanently to the tank.

2. Diaphragm shall be nylon reinforced Buna-N rubber or other approved material conforming to the interior shape of the tank.

3. Mount tank containing a full internal diaphragm with a minimum capacity of 200 gallons vertically on concrete housekeeping pad.

4. Store FFF concentrate inside the diaphragm. Concentrate shall not be in contact with the steel tank.

5. Tank shall have perforated PVC tubes inside the diaphragm to ensure full displacement of the stored concentrate.

6. Tank shall be equipped with the standard fittings and trim, including FFF fill and drain connections, water fill and drain connections, and concentrate sight glass.

E. Balanced Pressure Proportioner

1. Inline balanced pressure type unit capable of proportioning FFF liquid at 3 percent (3 parts concentrate to 97 parts water by volume) solution, at flow rates within the floe range of the proportioner.

2. Proportioner body, inlet nozzle and metering orifice shall be brass, bronze or stainless steel.

3. Mark the flow direction, the type and percent of concentration clearly on the proportioner body.

4. Inline balanced proportioner shall include integral pressure balancing valve with duplex pressure gauge, inlet pressure gauge, and manual ball valve.

5. Proportioner assembly shall be factory assembled and tested as an assembly by one manufacturer. The assembly shall be FM approved and listed

F. FFF Concentrate Control Valve Assembly

1. FFF concentrate control valve assembly shall control concentrate to the proportioner and arrange to open upon application of water or FFF solution pressure from the alarm check or automated water control valve.

2. Valve shall be brass, bronze or stainless steel. Internal components shall be coated with a material compatible with the concentrate liquid.

3. All components shall be rated for 175 psi.

4. Valve shall be certified by the manufacturer to be operable at an inlet water pressure as low as 30 psi.

## 2.09 CONTROL SYSTEM – GENERAL

A. All control systems shall be UL Listed and/or FM approved and be utilized with listed or approved compatible operating devices and shall be capable of the following functions:

1. Ground fault indication

2. Supervised alarm circuits

3. Supervised primary power circuit

4. Remote Trouble Alarm

5. Battery standby

6. Front panel indicating lamps (LEDs) or (LCD) display

7. Key lock steel enclosure

## 2.10 CONTROL PANEL

A. The control panel shall be a UL Listed and/or FM Approved microprocessor-controlled control panel. Provide AUTOPULSE Deluge Panel or approved equal.

B. The door shall include a keyed lock and a glass or other transparent opening for viewing of all indicators.

C. All interfaces and associated equipment shall be protected so they will not be affected by voltage surges or line transients.

D. The control panel shall receive one 120V dedicated power feed.

## 2.11 POWER SUPPLY

A. Each power supply shall operate on 120VAC, 60 Hz, and shall provide all necessary power for the foam fire protection system.

B. Power supply shall provide a battery charger for 24 hours of standby.

C. Power supply shall provide an earth detection circuit.

D. Power supply shall provide optional meters to indicate battery voltage and charging current.

## 2.12 BATTERIES

A. Batteries shall be 12V.

B. Batteries shall have sufficient capacity to power each fire alarm system for not less than 24 hours in standby plus 5 minutes of alarm upon a normal AC power failure.

C. Batteries are to be completely maintenance free. No liquids are required. Fluid level checks, refilling, spills, and leakage are not acceptable.

# PART 3 - EXECUTION

## 3.01 INSTALLATION AND TESTING

A. The Contractor shall hydrostatically test the entire fire protection system at 200 psi (13.8 bar) for 2 hours. Bladder tanks shall be isolated by manual valves and not be included in this test. For the hydrostatic test, the water pressure shall be increased in 50-psi (3.5-bar) increments with observations of the joint and gasket stability during each step increase. Increase pressure to the next increment only after joint and gasket stability has been demonstrated. After the required hydrostatic test pressure has been reached and maintained for 1 hour, the pressure shall be returned to zero while examining for leakage. The pressure shall be slowly increased again to the required

hydrostatic test pressure and maintained for 2 hours while the leakage measurement is determined. All lines shall be relieved of pressure after completion of the test. In the event of repairs or additions, the affected piping shall be retested at the Contractor's expense. A Contractor's Material and Test Certificate shall be furnished by the Contractor and countersigned by the Engineer. All shutoff valves shall be fully closed and opened under system pressure to ensure proper operation.

B. The Contractor shall coordinate with Owner any activity requiring an interface with existing plant services or other contractors to implement fire protection in the building(s).

C. The Contractor shall protect piping and system components from freezing in exterior or unheated spaces.

D. Sprinkler piping shall be installed so that the entire system may be drained. Piping to sprinkler heads shall be connected into the top of sprinkler main or branch serving that head. Side or bottom connections are not permitted.

E. Mains, test connections, and other equipment shall be labeled as per FM and NFPA.

F. Pipe hangers and supports shall comply with NFPA.

G. Penetrations through fire walls and floors shall be provided using appropriate methods to maintain their integrity as per NFPA.

H. Electrical installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

I. All conduit, junction boxes, conduit supports, and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

J. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

K. Provide the service of a competent factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. The factory representative shall demonstrate that the foam fire protection systems function properly in every respect.

L. Inspectors test connections shall be provided as required by NFPA and the local fire marshal.

M. All piping shall be closely coordinated with other trades (process piping, utility piping, HVAC, plumbing, electrical, general construction) to avoid interferences.

N. Fire protection systems installed in electrical rooms noted on the Drawings shall have welded sprinkler piping. All screwed connections shall be backwelded except sprinkler head connections. Sprinkler heads shall not be located directly above electrical equipment.

O. Foam fire protection systems shall be tested only after all hydraulic testing and flushing is complete and all deficiencies found have been corrected to the satisfaction of the Owner.

P. Foam Discharge and Concentration Testing

1. Test each system riser at full design flow of foam solution from the individual riser or through temporary hose lines and nozzle to a test header for at least 60 seconds to collect a foam solution sample.

2. Test all foam-water hose line by full flow of foam solution for at least 60 seconds to collect a foam solution sample.

3. The manufacturer's representative shall test samples of foam solution taken from each system to ensure proper FFF concentration by means of refractive index. Provide protection for all electrical fixtures and equipment exposed to possible damage during the tests and protect doors and other openings leading from the protected area, to prevent migration of the foam solution into other areas or spaces.

4. Flushing and Rinsing: After completion of tests, flush all piping carrying foam solution with fresh water.

5. Environmental Protection: Provide temporary measures to prevent foam solution from entering storm drains, sanitary sewers, drainage ditches, streams and water courses. Contain all foam solution on paved surfaces or specific containment area. Collect all discharge foam solution and dispose of it in an EPA approved wastewater treatment facility that provides a secondary (biological) treatment.

6. Foam Concentrate Storage Tank: After acceptance of the system testing, bladder tanks shall be charged to the required tank capacity.

## 3.02 WARRANTY TERMS

A. The Contractor shall warranty all work performed and all material and equipment furnished under this Contract to be free from defects and shall remain so for a period of at least 1 year from the date of acceptance.

## 3.04 INSTALLATION

A. Installation shall be accomplished by the licensed Subcontractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

D. Drains: Drains shall be of adequate size to readily carry the full flow from each drain under maximum pressure. Install drips and drains where necessary and required by NFPA 13.

E. Supervisory Switches: Provide UL/FM supervisory switches for sprinkler control valves.

F. Waterflow Alarm Switches: Install UL/FM waterflow switch and adjacent valves in easily accessible locations.

G. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

H. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.

## 3.05 INSPECTION AND TESTING

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13. Connection to the fire alarm system shall have been in service for at least 10 days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

## 3.06 ON-SITE TRAINING

A. The Fire Protection Subcontractor shall conduct a traininas designated by the contract in the presence of the Resident Engineerting Officer. Submit proposed schedule, lesson plan, materials, etc. as specified in Section 01 79 00 – Instruction of Owner's Personnel. Training shall be provided for a period of time as specified in Section 01 79 00 – Instruction of Owner's Personnel and shall start after the system is functionally complete and after the Final Acceptance Test. Submit Operating and Maintenance Manuals as specified in Section 01 78 23 – Operation and Maintenance Data prior to training. The on-site training shall cover all of the items contained in the approved manuals.

**END OF SECTION**

# SECTION 22 05 00
# BASIC PLUMBING REQUIREMENTS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes

1. Furnish services, skilled and common labor, and apparatus and materials required for the complete installation as shown and within the intent of the Drawings and/or these Specifications.

2. Requirements of this Section apply to all Specification Sections in Division 22 – Plumbing.

C. Related Sections

1. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

2. Section 01 75 00 – Checkout and Startup Procedures

3. Division 09 – Finishes

4. Division 22 – Plumbing

5. Section 26 05 00 – Basic Electrical Requirements

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

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B. Refer to General Conditions and Division 01 – General Requirements for the list of applicable regulatory requirements.

1. Comply with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

## 1.03 DESCRIPTION

A. These Division 22 Specification Sections define the statutory, administrative, procedural, and technical requirements of the mechanical and controls modifications, replacements, and/or upgrades products and services to be provided under this Contract.

B. Provide plumbing work as indicated on the Drawings and specified in Division 22 – Plumbing including:

1. Prepare coordination drawings, shop drawings, submittals, as-built drawings, and operating and maintenance instructions.

2. Determine items and quantities required.

3. Provide complete, continuous, operational, and functioning systems.

4. Fully coordinate with work of other Sections, including field verification of elevations, dimensions, clearance, and access.

5. Repair of all damage done to premises as a result of this installation and removal of debris left by those engaged in this installation.

6. Rigging, hoisting, transportation, and associated work necessary for placement of equipment in the final location shown.

7. Disassembly and reassembly of equipment furnished under this Section, should this be required in order to move equipment into final location shown on the Drawings.

8. Labor, materials, tools, appliances and equipment that are required to furnish and install the complete installation for this portion of the Work including that which is reasonably inferred.

9. Cooperation with other crafts in putting the installation in place at a time when space required is accessible.

10. Temporary scaffolding necessary for performance of the work under Division 22.

11. Cutting and core drilling required for work of Division 22, including locating of rebar or coordination of locating rebar with the Contractor.

12. Pipe sleeves for all holes in walls, floors, and ceilings and cutting of floor slabs and slabs on grade.

13. Waterproofing where necessary for installation under Division 22.

14. Cooperation with and assistance to the Instrumentation and Control System Subcontractor as required to provide a complete and functional plumbing system.

15. Counterflashing of roof penetrations for work of Division 22.

16. Sizes, and locations for installation of any curbs and pads for work of Division 22.

17. Temporary and permanent stands and supports for equipment requiring them including vibration isolation.

18. Temporary protection of existing installation.

19. Stenciling and equipment identification.

20. Firestopping of penetrations of ducts, piping, and conduits through walls, floors, and ceiling assemblies.

21. Temporary utilities as required to install work of Division 22 including lighting, water, gas, electricity, etc.

22. Fees, permits, inspections, taxes, and approach from agencies that have jurisdiction over installation of work of Division 22.

23. Participation in and coordination with the Commissioning process.

24. Warranty.

## 1.04 SUBMITTALS

A. Submit under provisions of General Conditions, Supplementary Conditions and Division 01 – General Requirements.

B. Product Data: Submit manufacturer's technical product specification sheets for each system component and device to be provided that includes data needed to prove compliance with this Section. Clearly indicate the exact model of each component to be provided.

C. Shop Drawings: The Contractor shall submit for approval shop drawings prepared in accordance with Section 01 33 00 – Submittal Procedures and as required by other Sections of the Specifications.

1. Shop drawings shall be drawn to a scale of 1/4 inch = 1 foot (1:25) or larger, and shall include complete dimensions, locations, elevations, and clearances for plumbing, piping, ductwork, equipment, and valve numbers.

    a. Prepare in AutoCAD format or as otherwise directed.

    b. Identify equipment using designations shown on the Contract Documents or as directed by the Engineer. Do not proceed with identifications without approval from the Engineer.

2. All shop drawings shall clearly call out in bold letters and cloud symbols deviations from the Specifications and Contract Documents, no matter how minor.

D. Coordination Drawings

1. Obtain drawings from the structural, electrical, sprinkler, plumbing, sheet metal, concrete, steel, and dry wall trades.

2. Hold regular coordination sessions with trades until coordination issues are resolved.

3. Prepare separate composite coordination drawings to a scale of 1/4 inch = 1 foot (1:25) or larger, showing work of Divisions to demonstrate coordination, clearance, access, etc. between ductwork, equipment, temperature controls, cable trays, conduits, light fixtures, piping, plumbing, structural elements, architectural elements, etc. These drawings are to be the basis for the detailed shop drawings and need not be submitted, but shall be available for review upon request.

    a. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

    b. Each trade shall adjust their shop drawings based on the outcome of coordination sessions.

4. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work.

5. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

6. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:

    a. Clearances for installing and maintaining insulation.

    b. Clearances for servicing and maintaining equipment, including specific ceiling tile or ceiling access panel access and space for equipment disassembly required for periodic maintenance.

    c. Equipment connections and support details.

    d. Fire-rated wall and floor penetrations.

    e. Sizes and locations of required concrete pads and bases.

    f. Valve stem movement.

    g. Sizes and locations of new and existing equipment support curbs on roof.

    h. Sizes and locations of new openings, either sleeved, cut, or core-drilled, in new concrete construction unless specifically shown on the Structural Drawings.

7. Maintain one complete set of composite coordination drawings at the Project Site. Periodically update drawings based on actual field conditions.

8. Submit final coordination drawings as part of record document requirements.

E. Submit manufacturer's Operation and Maintenance (O&M) manuals in compliance with Section 01 78 23 – Operation and Maintenance Data. Include a list of spare parts that the manufacturer recommends the Owner purchase.

F. Lateral Force Anchorage: Submit lateral force anchorage calculations and details of anchorage of components to building including backing design. Seismic forces shall be in accordance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components with value 1.5 used as the minimum CBC seismic importance factor, Ip. Calculations shall be sealed by a Structural Engineer registered in the state of Georgia.

G. Record Documents: Upon completion of the Work covered by this Contract, as directed, furnish as-built drawings as specified in Division 01 – General Requirements. Include changes installed under this Contract which are not in accordance with the Contract Drawings. Note that these as-built drawings are to be based on the Contract Drawings. In addition, submit final copies of the Shop Drawings and Coordination Drawings.

## 1.05 QUALITY ASSURANCE

A. Materials and Equipment: Materials and equipment shall be new. Materials and equipment for which tests have been established by UL shall be approved by that body and shall bear its label of approval.

1. The first-named manufacturer and product is the basis of design. Other manufacturers and/or products are considered as substitutions.

B. In lieu of listing by an approved testing laboratory, consideration will be given to certified test reports of an adequately equipped, recognized independent test laboratory competent to perform such testing indicating conformance to requirements of the applicable UL standards.

C. Unless otherwise approved by the Engineer, the materials to be furnished under this Section shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to the material specified, and shall be the manufacturer's latest standard design that complies with the specified requirements.

D. Approval of Materials

1. See General Conditions and Division 01 – General Requirements for requirements for materials and equipment and submittals.

2. A complete list of materials and equipment proposed shall be submitted to the Engineer for approval. The list shall include for each item: the manufacturer, the manufacturer's catalog number, type or class, the rating, capacity, size, etc.

3. Before installation of the equipment, the Contractor shall submit for approval detailed construction drawings for each item of fabricated equipment required for installation. Drawings shall be to scale and fully dimensioned and shall provide sufficient detail to clearly indicate the arrangement of equipment and its components.

4. Installation of approved substituted equipment is the Contractor's responsibility, and changes required to work included under other Divisions for installations of approved substituted equipment must be made to the satisfaction of the Engineer and without change in Contract Price. Approval by the Engineer of substituted equipment and/or dimension drawings does not waive these requirements.

## 1.06 RULES AND REGULATIONS

A. See Division 01 – General Requirements.

B. Provide work and materials in full accordance with the latest rules of the organizations listed in Division 01 – General Requirements and in other Sections of Division 22 –

Plumbing, and with prevailing rules and regulations pertaining to adequate protection and/or guarding of moving parts, or otherwise hazardous locations.

C. Whenever the Drawings and Specifications require something which will violate the regulations, the regulations shall govern. Review the Drawings and Specifications and request from the Engineer clarification or revision of portion of the work in violation of the rules or regulations prior to installing the work. Necessary installation alteration required for compliance shall be made at no additional cost to the Owner.

D. Whenever the Drawings and Specifications require larger sizes, or higher standards than are required by the regulations, the Drawings and Specifications shall govern.

E. Strictly conform to the requirements of NFPA, the NEC, International Building Codes, OSHA, Fire Marshal, and insurance underwriters. Expenses required shall be borne under this Contract.

## 1.07 PROTECTION OF EQUIPMENT

A. Protect, handle, and store products under provisions of Division 01 – General Requirements.

B. Assume responsibility for damage to the work or premises before Substantial Completion. Should new or existing equipment become damaged, restore it to its original condition and finish before Final Acceptance. Damage incurred to the property or to the work of other Divisions caused by the work under this Division shall be replaced or repaired by, and at the expense of, the Plumbing Subcontractor to the satisfaction of the Engineer. Exposed materials shall be clean at the time of acceptance of the project.

## 1.08 SCHEDULING AND SEQUENCING

A. Cooperate with other trades in putting this installation in place at a time when space required is accessible and in such a manner that other work in this space may be installed as shown on the Drawings. Schedule work and cooperate with the others to avoid delays, interferences, and unnecessary work, conforming to the construction schedule, making the installation when and where directed.

B. Include labor and materials to install certain items furnished under this Contract when required by the schedule. These items are part of this Contract but may need to be installed only after completion of work under another contract which this Contractor may or may not be participating in. It is the responsibility of the Contractor to coordinate with others to ensure that preparations are made and ready to accept the installation of these items. These items include, but are not limited to:

1. Air inlets and outlets

2. Temperature sensors

3. Monitoring and control panels

4. Sprinkler heads

C. If a discrepancy is discovered between Drawings, whether with respect to a significant variance between location, variation in quantity, or violation of code requirements, notify Engineer for clarification and do not proceed with the work affected until clarification has been made.

D. Schedule work in advance with the Engineer. No system shall be shut down unless approved in writing.

## 1.09 TEMPORARY USE

A. Should it become necessary to use the new portion of the system and the new equipment to warm or air condition part of the building before the completion of the Work, the Owner reserves the right to make use of same at its own risk and expense, but the temporary use of the equipment shall not constitute an acceptance of the system or part thereof in way. The Owner will bear the cost of fuel and electricity for such temporary use of the equipment. If temporary use of new systems or equipment is solely for the benefit of the Contractor, Contractor shall bear the cost of fuel and electricity for such temporary use.

## 1.10 WARRANTY

A. Comply with General Conditions and Division 01 – General Requirements.

B. Provide extended warranties where specifically required in other Sections of Division 22 – Plumbing.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. In addition to material and equipment specified, provide incidental materials to result in a complete installation. Such incidental materials include solders, tapes, caulkings, mastics, gaskets and similar items.

B. Materials and equipment shall be uniform throughout the installation. Equipment of the same type shall be of the same manufacturer. Materials and equipment shall be new.

## 2.02 MATERIALS AND SUBSTITUTIONS

A. Comply with General Conditions and Division 01 – General Requirements.

## PART 3 – EXECUTION

### 3.01 EXAMINATION OF SITE

A. Examine the site and become familiar with conditions that may affect the work covered by Division 22 – Plumbing.

B. Arrange to meet with the Engineer at the Project site before the plumbing work is started and discuss with them the various phases of the Work and the procedure and preparation for testing and adjusting the systems.

C. The general arrangement and location of piping ductwork, apparatus, etc., is shown on the Drawings or specified herein. Minor changes may be necessary to accommodate other work, new or existing, that may conflict with this work. Install and fully coordinate this work in harmony with these trades.

D. Visit the Project Site, take measurements, examine areas where plumbing work is to be performed and get such other information necessary for proper execution of the plumbing work. Ascertain and check conditions with the Drawings and Specifications, other trades, existing conditions and by what means the plumbing work is to be performed. No allowance shall subsequently be made for extra expense due to failure or neglect to make such examination and correlation. Where revisions or changes in the existing work are required to permit the installation of new work, they shall be made at no additional cost to the Owner. No allowance shall be subsequently made for error or omission.

### 3.02 ACCURACY OF DATA

A. The Drawings indicate the general arrangement and location of piping, ducts, and equipment. Should it be necessary to deviate from arrangement or location indicated in order to meet architectural conditions or site conditions, or due to interference with other work, make such deviations as offsets, rises and drops in piping and ducts that may be necessary, whether shown or not, without extra cost to the Owner. Extreme accuracy of the data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for the assistance and guidance of this Section and exact locations, distances, and elevations shall be governed by actual site conditions.

### 3.03 COORDINATION ITEMS

A. Coordinate mechanical work with that of other trades in order to:

1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.

2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.

3. Indicate aisleways and accessways required on coordinated shop drawings for roof equipment area, mechanical equipment rooms, data and telecommunications rooms, corridors, ceiling spaces, shafts, corridors, ceiling space, laboratories, etc.

B. Understanding of Work

1. Study, examine, and compare the Contract Documents, including Drawings and Specifications. The Plumbing Subcontractor shall have a full understanding of how the plumbing work is scheduled, phased, and installed with work of other trades.

2. Include in this installation piping, ductwork, devices, and equipment that are necessary for complete and operating systems as specified and as required.

3. Connect piping and ductwork from fixtures, outlets, and devices full size to the nearest suitable main or riser.

4. Certain installations may be presented as typical, and full details are not repeated for each case. Plumbing Subcontractor shall provide complete installation as if full details apply to each and every case and make adjustments to typical details to suit each specific installation as part of the basic work.

5. Installation of work presented on the diagrams are applicable to the plans, and work depicted on the plans are applicable to the diagrams.

6. If there is a discrepancy in the Drawings or Specifications, the Contractor shall plan the work based on the most stringent requirements to complete the installation and obtain clarification from the Engineer before installation.

C. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.

2. Verify dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. Work shall be above ceilings or ceiling line.

7. Coordinate installation and connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Coordinate with individual system requirements.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as is practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

12. Coordinate with the locations of electrical panels and avoid installing piping and ductwork over them. Electrical panels are purposely located and have priority for location. The Contractor is responsible for required piping and ductwork offsets to ensure that the panels are located as designed and for other conditions.

13. Perform system modification recommended by Test and Balance Agency after recommendations are accepted by the Engineer.

## 3.04 WORKMANSHIP AND SUPERVISION

A. Comply with requirements of the General Conditions, Supplementary Conditions, Division 01 – General Requirements and the following:

1. Measurements: Materials installed shall be to exact field measurements.

2. The installation depicted on the Drawings is designed to fit tightly into work under other Sections or Divisions. It is the essence of this Contract that work be completely coordinated with other Sections or Divisions, and that locations of pipes and ducts be exactly determined in the field and cleared with other Sections or

Divisions before the installation of these items is begun. No extra compensation will be made for failure to observe this clause.

3. Adequate clearance for access to operable devices and automatic devices and for access to lubrication points shall be maintained in portions of the work including ductwork and piping installed on the roof. Tripping hazards shall be avoided.

4. Provide architectural access doors where shown and where required for access to equipment and operable devices.

5. Gauges, thermometers, and other indicating devices shall be installed so that they can be easily read from the floor.

## 3.05 MATERIAL DELIVERY AND STORAGE

A. Comply with Section 01 65 00 – Product Delivery Requirements.

B. Comply with Section 01 66 00 – Product Storage and Protection Requirements.

## 3.06 INSTALLATION

A. Manufacturer's Directions: Follow manufacturer's directions covering points not shown on the Drawings or specified herein. Manufacturer's directions do not take precedence over Drawings and Specifications. Where these are in conflict with the Drawings and Specifications, notify the Engineer for clarification before installing the work.

B. Carpentry, Cutting, Patching, and Core Drilling

1. Provide carpentry, cutting, patching, and core drilling required for installation of material and equipment specified in this Division.

2. No penetrations shall be sleeved, cut, or core drilled through concrete construction without a submittal indicating exact locations and sizes and specific written approval from the Engineer or unless specifically shown on the Structural Drawings.

3. It is the Plumbing Subcontractor's responsibility to accurately size and locate openings through the structure. The dimensions shown on the Structural Drawings are for general information only. Provide specific sizes, dimensions, requirements, etc.

C. Seismic Mounting

1. Material and equipment, including floor-mounted equipment, piping, and appurtenances shall comply with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

D. Waterproof Construction

1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior roof penetrations. Caulk penetrations of foundation walls and floors watertight. Provide membrane clamps at penetrations of waterproof membranes.

2. Provide waterproof NEMA 3R enclosures for equipment or devices mounted outside or otherwise exposed to the weather.

E. Sleeves, Stubs, and Slab Penetrations: Reference Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

F. Painting of Mechanical Equipment and Hardware

1. Comply with applicable portions of Division 09 – Finishes for paints and coatings.

2. Provide moisture-resistant paint for exterior painting.

3. Colors shall be as shown on the Drawings unless specified.

4. Comply with individual Sections for other equipment to be painted.

5. Repair damaged galvanizing, paint, or coatings. Use Z.R.C. (no known equal) cold galvanized compound for galvanized repairs.

G. Concrete Equipment Bases

1. All equipment located on concrete floor inside the building or on grade outside the building shall be mounted on a concrete base. The concrete base shall be 4 inches high and shall extend 6 inches beyond the edge of equipment base unless indicated otherwise on Drawings.

2. Coordinate Concrete Bases: Concrete bases indicated on Architectural or Structural Drawings are specified in other Divisions. Concrete bases not on Architectural or Structural drawings are requirements of this Division.

## 3.07 PIPING AND EQUIPMENT IDENTIFICATION

A. Comply with Section 22 05 53 – Identification for Plumbing Piping and Equipment.

## 3.08 SHUTDOWN AND SCHEDULING

A. Comply with provisions of General Conditions, Supplementary Conditions and Division 01 – General Requirements.

## 3.09 PROTECTION OF EQUIPMENT

A. Care shall be exercised during construction to avoid damage or disfigurement. Equipment shall be protected from dust and moisture prior to and during construction. The Plumbing Subcontractor is cautioned that concrete finishing, painting, etc. in electrical rooms shall not proceed if unprotected equipment is installed.

B. Where required or directed, construct temporary protection for equipment and installations for protection from dust and debris caused by construction.

C. All protection shall be substantially constructed with the use of clean canvas, heavy plastic, visqueen and plywood as required, and made tight and dustproof as directed.

D. The Plumbing Subcontractor shall repair by spray or brush painting, after properly preparing the surface, scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

E. Failure of the Plumbing Subcontractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

## 3.10 INSPECTIONS

A. Comply with provisions of General Conditions, Supplementary Conditions and Division 01 – General Requirements.

## 3.11 REMOVED EQUIPMENT AND MATERIALS

A. Comply with provisions of General Conditions, Supplementary Conditions and Division 01 – General Requirements.

## 3.12 CLEANING

A. Comply with provisions of General Conditions, Supplementary Conditions and Division 01 – General Requirements.

## 3.13 LUBRICATION

A. All lubrication points shall be accessible. Where this is impossible, provision shall be made for lubrication at an accessible location. Where oil is used, an oil level indicator and capped, vented filling connection shall be provided and firmly mounted in an accessible space and shall be connected to the bearing with pipe(s) as required. Where grease is used for lubricant, the pipe shall have a suitable lubricating fitting installed at the accessible end. Equipment shall be thoroughly lubricated before operation and at time work is accepted.

## 3.14 SEALANTS

A. See Division 07 – Thermal and Moisture Protection for sealing duct, pipe, and conduit penetrations through walls, partitions, and floors.

B. Completely seal duct, pipe and conduit penetrations through rated and non-rated walls.

## 3.15 TESTS

A. Upon completion of the mechanical construction work, perform tests and provide test reports as specified in this Section and other Sections.

1. All tests shall be made in the presence of a representative of the Engineer. The application or interruption of mechanical utilities shall be programmed and directed by the Engineer.

2. The Contractor shall submit to the Engineer three copies of test results, certified in writing, witnessed, signed and dated, immediately upon completion of associated work. Unsatisfactory conditions revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be corrected by the Plumbing Subcontractor to the satisfaction of the Engineer.

3. The Engineer reserves the right to require that the Contractor perform and repeat tests that are deemed necessary to complete or check the tests or the certified records of the Plumbing Subcontractor during the course of the work. Correct unsatisfactory portion of their work that is revealed by the tests or that may be due to progressive deterioration during this period, unless the item in question was a direct specification.

## 3.16 COMMISSIONING

A. Perform commissioning requirements of:

1. Section 01 75 00 – Checkout and Startup Procedures

2. Section 22 08 00 – Commissioning of Plumbing System

3. Section 23 08 00 – Commissioning of HVAC System

4. Section 26 05 00 – Basic Electrical Requirements

B. Commissioning is included as a part of the total package of quality assurance and quality control for the Project. Commissioning shall be integrated into the Project as the process that oversees and verifies the functional performance of equipment, systems, and assemblies via observation and testing. Include coordination with and full participation in the commissioning process. Commissioning shall include but not be limited to field observations, factory and site tests, pre-start checks, startup checks,

functional test procedure review, functional testing, commissioning meetings, documentation, test interpretation, and deficiency correction. The details of these requirements are described in the previously referenced Sections and other referenced Sections and are hereby incorporated by reference into the work of this Division.

## 3.17 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Refer to General Conditions, Supplementary Conditions and Division 01 – General Requirements for operating and maintenance instructions and requirements.

**END OF SECTION**

## SECTION 22 05 19
## METERS AND GAUGES FOR PLUMBING PIPING

### PART 1 – GENERAL

### 1.01 DESCRIPTION

A. This Section describes the requirements for water meters and gauges primarily used for troubleshooting the system and to indicate system performance.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 00 – Basic Plumbing Requirements.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 22 05 00 – Basic Plumbing Requirements

### 1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASME

1. B40.100 – Pressure Gauges and Gauge Attachments

2. B40.200 – Thermometers, Direct Reading and Remote Reading

C. AWWA

1. C700 – Standard for Cold Water Meters, Displacement Type, Bronze Main Case

2. C701 – Cold Water Meters-Turbine Type, for Customer Service

3. C702 – Cold Water Meters – Compound Type

4. C706 – Direct-Reading, Remote-Registration Systems for Cold-Water Meters

D. IEEE

1. C2 – National Electrical Safety Code (NESC)

E. ICC

1. IPC – International Plumbing Code

F. NFPA

1. 70 – National Electrical Code (NEC)

G. NSF

1. 61-2012 – Drinking Water System Components – Health Effects

2. 372-2011 – Drinking Water System Components – Lead Content

## 1.04 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Manufacturer's Literature and Data: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Water meter

2. Pressure gauges

3. Thermometers

4. Product certificates for each type of meter and gauge

5. BACnet communication protocol

C. Operations and Maintenance (O&M) manual shall include:

1. System description

2. Major assembly block diagrams

3. Troubleshooting and preventive maintenance guidelines

4. Spare parts information

D. Shop Drawings shall include the following: One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

## 1.05 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit copies of complete O&M data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three-ring binder per the requirements of Section 01 33 00 – Submittal Procedures. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the O&M manual. The O&M manual shall include troubleshooting techniques and procedures for emergency situations. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

## PART 2 – PRODUCTS

### 2.01 REMOTE READOUT REGISTER

A. All meters shall be equipped with a remote readout register in accordance with AWWA C706.

### 2.02 PRESSURE GAUGES FOR WATER AND SEWAGE USAGE

A. ASME B40.100 all metal case 115-mm- (4-1/2-inch-) diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 1380 kPa (0 to 200 psig) gauge.

B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.

C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psig.

D. The pointer shall be dark colored metal.

E. The window shall be glass.

F. The ring shall be brass or stainless steel.

G. The accuracy shall be grade A, +/-1 percent of middle half of scale range.

H. The pressure gauge for water domestic use shall conform to NSF 61 and NSF 372.

### 2.03 THERMOMETERS

A. Thermometers shall be straight stem, metal case, red liquid-filled thermometer, approximately 175 mm (7 inches) high, 4 to 100 degrees C (40 to 212 degrees F). Thermometers shall comply with ASME B40.200.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Direct mounted pressure gauges shall be installed in piping tees with pressure gauge located on pipe at the most readable position.

B. Valves and snubbers shall be installed in piping for each pressure gauge.

C. Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.

D. Pressure gauges shall be installed where indicated on the Drawings and at the following locations:

1. Building water service entrance into building

2. Inlet and outlet of each pressure reducing valve

3. Suction and discharge of each domestic water pump or recirculating hot water return pump

E. Water meter installation shall conform to AWWA C700, AWWA C701, and AWWA C702. Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. New materials shall be provided.

F. Remote readout register shall be mounted at the location indicated on the Drawings or as directed by the COR.

G. Thermometers shall be installed on the water heater inlet and outlet piping, thermostatic mixing valve outlet piping, and the hot water circulation pump inlet piping.

H. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Owner.

### 3.02 FIELD QUALITY CONTROL

A. The meter assembly shall be visually inspected and operationally tested. The correct multiplier placement on the face of the meter shall be verified.

**END OF SECTION**

## SECTION 22 05 29
## HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes

1. Pipe, duct, and equipment hangers and supports

2. Anchors, equipment bases and supports

3. Sleeves and seals

4. Flashing, counter flashing and pipe stacks

5. Firestopping

C. Related Sections

1. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

2. Division 03 – Concrete

3. Section 05 05 23 – Metal Fastening

4. Section 07 84 00 – Firestopping

5. Section 07 90 00 – Joint Fillers, Sealants and Caulking

6. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment

7. Section 22 07 19 – Plumbing Piping Insulation

8. Section 22 11 13 – Facility Water Distribution Piping

9. Section 23 31 13 – Metal Ducts and Duct Accessories

12-03-2024

## 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

3. Refer to General Conditions for the list of applicable regulatory requirements.

4. Refer to Section 22 05 00 – Basic Plumbing Requirements for codes and standards and other general requirements.

B. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

C. Code of Federal Regulations 29 CFR 1910.7:

1. Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

D. NFPA

1. NFPA 13 – Installation of Sprinkler Systems

2. NFPA 14 – Installation of Standpipe and Hose Systems

E. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components for seismic bracing of ductwork and piping.

F. UL Fire Resistance Directory, latest edition

## 1.03 SUBMITTALS

A. Submit under provisions of Section 22 05 00 – Basic Plumbing Requirements for review of materials, Section 01 33 00 – Submittal Procedures, and General Conditions.

B. Submit calculations showing compliance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components, for piece of equipment whether supported or braced from above or below.

C. Submit calculations showing compliance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components for seismic bracing of ductwork and piping.

D. Submit shop drawing of hanger and support spacing, framing and attachment methods.

E. Submit firestopping systems for every application.

## 1.04 QUALITY ASSURANCE

A. Comply with the following:

1. Supports for Sprinkler Piping: NFPA 13

2. Supports for Standpipes: NFPA 14

B. Do not use black steel devices, components, fasteners, etc. in related air flow path. Steel items shall be plated, galvanized, painted, or coated.

# PART 2 – PRODUCTS

## 2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2- to 1-1/2-Inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.

B. Hangers for Pipe Sizes 2 Inches and Cold Pipe Sizes 6 Inches and Larger: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.

C. Hangers for Hot Pipe Sizes 6 Inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.

D. Trapeze Supports: 12-gauge channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and; cast iron roll and stand for hot pipe sizes 6 inches and larger.

E. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12-gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping. and adjustable steel yoke and cast iron roll for hot-pipe sizes 6 inches and larger.

F. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.

G. Floor Support for Pipe Sizes to 4 Inches and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

H. Floor Support for Hot Pipe Sizes 6 Inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

I. Shield for Insulated Piping 2 Inches and Smaller: 18-gauge galvanized steel shield over insulation in 180 degree segments, at least 12 inches long at pipe support.

J. Pipe Shields: Pipe Shields Inc., FRI, or equal, pipe hanger shield with waterproofed calcium silicate insulation encased in a galvanized metal casing completely around the pipe. Provide insulation same thickness as pipe insulation. Furnish the following models:

1. Chilled Water: A2000 with calcium silicate insulation extending 1 inch beyond the metal casing

2. All others: A1000

K. Concrete Anchors: In accordance with Section 05 05 23 – Metal Fastening.

## 2.02 DUCT SUPPORTS

A. See Section 23 31 13 – Metal Ducts and Duct Accessories

## 2.03 HANGER RODS

A. Steel, threaded both ends, threaded one end, or continuously threaded.

## 2.04 ATTACHMENTS TO STRUCTURE

A. Inserts for new formed concrete construction: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. For Suspension from New Formed Concrete Structure: Grinnell Figure 282, Superstrut 452, or equal, UL listed for the rod sizes, Grinnell, Fig. 282, Superstrut 452, or equal.

C. Connection to Existing Concrete Structure: Hilti Kwik-Bolt, Phillips or equal, wedge type expansion anchors. Powder-driven fasteners may be used only for flexible duct, metal duct up to 16 inches round (or rectangular equivalent), and for air inlet and outlet wire seismic braces, and only within the parameters of the fastener's ICBO report. Provide current ICBO report. Do not use powder-driven fasteners for pipes or conduits.

D. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.

E. For Support on New Concrete: Galvanized steel headed bolts.

F. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.

G. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

## 2.05 SUPPORTS, BRACING, AND ACCESSORIES

A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize steel parts after fabrication where used outdoors or inside the penthouse.

B. Fasteners: Bolts and nuts, except as otherwise specified, shall conform to ASTM A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. Bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. Ferrous metal components below grade shall be stainless steel.

C. Sheet Metal Screws: Plated, size 10 minimum.

D. Pre-engineered duct and pipe bracing systems shall be Mason Industries Seismic Sway Brace System or equal.

## 2.06 COUNTER FLASHING

A. Metal Flashing: 26-gauge galvanized steel

B. Flexible Flashing: 47-mil thick sheet butyl; compatible with roofing

C. Caps: Steel, 16 gauge

## 2.07 EQUIPMENT CURBS

A. See Architectural and Structural Drawings for the design detail of the equipment curb.

## 2.08 SLEEVES

A. Adjust-To-Crete, AMI Products, or equal, 24-gauge, electro-galvanized adjustable sleeve, up to 6-inch diameter. For 8 inches and larger, provide galvanized standard weight steel pipe sleeves.

B. Sleeves for Round Ductwork: Form with galvanized steel.

C. Sleeves for Rectangular Ductwork: Form with galvanized steel or wood.

D. Caulk: Acrylic sealant of quality specified in Section 07 90 00 – Joint Fillers, Sealants and Caulking.

## 2.09 FIREPROOFING OF FLOOR AND WALL PENETRATIONS

A. Materials and installation shall comply with UL Fire Resistance Directory for Through-Penetration for Firestop Devices, latest edition. See Section 07 84 00 – Firestopping.

## 2.10 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers for installation without disengagement of supported pipe.

## 2.11 FINISH

A. Prime-paint exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

B. Hot-Dip Galvanized Outdoors

1. Repair damage to galvanizing at welds, scratches, etc. using Z.R.C. (no known equal) cold galvanizing compound.

# PART 3 – EXECUTION

## 3.01 ATTACHMENTS TO STRUCTURE

A. Concrete Structure: Locate anchors from Edge condition and at a spacing to obtain maximum working loads specified in the applicable ICC report.

1. See Structural Drawings for additional restrictions for locating anchors.

B. Steel Structure: Attach at beam axis. Avoid eccentric loads wherever possible.

C. Rating: Ultimate strength at least 5 times the imposed load.

D. Submit for structural review pipe hanger locations, point loads and structural attachment details for pipes 6 inches and larger.

E. Coordinate installation so that attachments to structure are made prior to fireproofing. If attachments must be made after fireproofing, then thoroughly clean area of fireproofing before welded or bolted attachments are made and replace fireproofing as necessary. Fireproofing material shall match existing.

F. Where point loads imposed by work of Division 22 – Plumbing are greater than can safely be carried by the roof or deck, provide structural steel spreader beams tied to the building structure. Submit details of such spreader beams for approval.

G. Inserts

1. Furnish inserts per Division 03 – Concrete for placement in concrete formwork.

2. Furnish inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Furnish hooked rod per Division 03 – Concrete for inserts carrying pipe larger than 4 inches.

4. Where concrete slabs form finished ceiling, furnish inserts to be flush with slab surface.

5. Where inserts are omitted, submit an attachment plan to the Engineer.

## 3.02 SUPPORTS, BRACING, AND ACCESSORIES

A. Common Support Systems: This Section covers the provision, coordination, calculations, and seismic bracing of support systems common to Division 22 – Plumbing work. Individual sections shall be provided with their own horizontal support struts. The requirements of Division 22 – Plumbing shall be coordinated with other Divisions for all aspects of hanger installation, horizontal strut installation, pipe/conduit/cable tray/etc. installation, seismic bracing installation, etc.

B. Set machines and devices dead level, except where pitch or slope is specified or shown. Securely fasten to the structure unless shown otherwise. Use dry pack cement grout to obtain complete contact between structure and equipment.

C. This Section covers the concrete work for the support of equipment provided by this Section. Coordinate locations with anchor bolts before concrete is placed.

D. Pipe Hangers and Supports

1. Support horizontal piping as follows:

| Pipe Material and/or Size (inches) | Maximum Hanger Spacing (feet) | Hanger Diameter (inches) |
|---|---|---|
| 1/2 to 1-1/4 | 6.5 | 3/8 |
| 1-1/2 to 2 | 10 | 3/8 |
| 2-1/2 to 3 | 10 | 1/2 |
| 4 to 6 | 10 | 5/8 |
| PVC (All sizes) | 6 | 3/8 |
| C.I. Bell and Spigot (or No-Hub) | 5 (at joints) | 3/8 |

2. Install hangers to provide at least 1/2 inch space between finished covering and adjacent work.

3. Place a hanger within 12 inches of each horizontal elbow.

4. Use hangers with at least 1-1/2 inch vertical adjustment.

5. Support horizontal cast iron pipe adjacent to each hub, with 5-foot maximum spacing between hangers.

6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers. Use specified pipe shields (if applicable). Trapeze size, and support size and spacing shall be governed by the cumulative weight of the supported piping. Maximum trapeze deflection shall be 1/240th of the span on a maximum stress of 15,000 psi, whichever is more stringent.

8. Support riser piping independently of connected horizontal piping.

9. Brace piping longitudinally and transversely as specified and indicated on the drawings. Design of the seismic bracing shall be in accordance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

10. Support pipe from the building structure so that there is no apparent deflection in pipe runs. Fit piping with steel sway braces and anchors to prevent vibration and/or horizontal displacement under load when required. Do not support from, or brace to, ducts, other pipes, conduit, or materials except building structure. Piping or equipment shall be immobile and shall not be supported or hung by wire, rope, plumber's tape, plastic ties, or blocking of any kind. Vertical piping running between floors shall be additionally supported at mid points in a rigid and immobile fashion. Exposed or concealed piping which can be physically moved, and which is not properly supported will not be accepted, and additional support or bracing will be required. Install seismic bracing as at locations as specified in the contract drawings.

11. Install and secure equipment with anchors and braces to floors, structural members and walls with sufficient backing, to prevent vibration and/or horizontal displacement under load and seismic force as hereinbefore specified. Follow manufacturer's recommendations for the installation of vibration isolators where required for equipment requiring such.

E. Equipment Bases and Supports

1. Comply with Division 03 – Concrete for concrete bases.

2. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

3. Construct support of steel members. Brace and fasten with flanges bolted to structure. Level equipment installed on steel rails using shims to compensate for the deflection of the steel.

4. Provide rigid anchors for pipes after vibration-isolation components are installed.

F. Counter Flashing

1. See Architectural Drawings for flashings.

2. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors, and roofs.

3. Counterflash vent and soil pipes projecting at least 3 inches above finished roof surface with lead worked at least 1 inch into hub, at least 8 inches clear on sides using 24-inch by 24-inch sheets. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.

4. Counterflash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides using at least 36-inch by 36-inch sheets. Fasten flashing to drain clamp device.

5. Seal floor, shower, mop sink, and drains watertight to adjacent materials.

6. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

7. Provide curbs for mechanical roof installations at least 14 inches high above roofing surface. Counterflash with flexible sheet and counterflash with sheet metal; seal watertight.

G. Sleeves:

1. Set sleeves in position in formwork. Provide reinforcing around sleeves.

2. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.

3. Where piping or ductwork penetrates floor, ceiling, or wall, close-off space between pipe or duct and adjacent work with fire-stopping insulation and caulk airtight. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.

4. Install chrome-plated steel escutcheons at finished surfaces.

## 3.03 SEISMIC RESTRAINTS

A. Provide support hangar system, equipment, ductwork and piping with seismic restraints in accordance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

B. Pipe seismic restraints shall not interfere with pipe thermal expansion loop action or pipe building joint expansion loop action.

**END OF SECTION**

## SECTION 22 05 48

## VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents:

1. Drawings and general requirements of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes

1. Inertia bases

2. Vibration isolation

C. Related Sections

1. The requirements of this Section apply to all Specification Sections under Division 22 – Plumbing.

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

3. Refer to General Conditions and Division 01 – General Requirements for the list of applicable regulatory requirements.

4. Refer to Section 22 05 00 – Common Results for Plumbing for codes and standards, vibration and noise, and other general requirements.

### 1.03 SUBMITTALS

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A. Submit under provisions of Section 22 05 00 – Common Results for Plumbing for review of materials, Section 01 33 00 – Submittal Procedures, and the General Conditions.

B. Product Data

1. Provide specific information for items described under the products section of this Specification, including specifications, descriptive drawings, catalog cuts, and descriptive literature, including make, model, dimensions, weight and interface description with other work, and indicating full compliance with specifications as outlined.

2. An itemized list showing items to be isolated, the isolator type, model number, isolator loading and deflection, and reference to specific drawing showing frame construction where applicable.

C. Shop Drawings

1. Indicate inertia bases and vibration isolator locations, with static and dynamic load on each.

2. Drawings showing intended locations.

3. Drawings showing equipment frame construction for each machine, including dimensions, structural member sizes, and support point locations.

4. Drawings showing methods for suspension, of support, and guides.

5. Drawings showing methods for isolation of piping, at penetrations of walls, slabs, etc.

D. Operations and Maintenance Data: Submit manufacturer's certificate that isolators are installed and adjusted to meet or exceed specified requirements.

## 1.04 QUALITY ASSURANCE

A. Maintain ASHRAE criteria for average noise criteria curves for equipment at full-load condition

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Mason or M.W. Sausse

B. Isolation equipment shall be supplied by a single manufacturer. The following model numbers are Mason's. Vibration isolation components (isolators, snubbers, rails, and inertia bases) to be hot-dip galvanized. Welded steel channel perimeter frame with welded-in reinforcing bars, prelocated welded-in anchor bolts or prelocated bolt holes suitable for the number and size required, and height saving brackets where required. Inertia bases shall be 1.5 times the weight of the equipment. Snubbers shall be

provided. Delete inertia base requirement if the equipment is provided with motor rating of less than 15 hp and is provided with steel frame base.

C. Type "A" Support from Below with Spring Isolators: Model SSLFH captive spring mount for seismic and restrained service with leveling bolts, corrosion resistant finish, and 1/4-inch (6-mm) ribbed neoprene base pad. Provide optional baseplate with bolt holes where required. Furnish vibration isolation products from a single manufacturer. The only exception is internal vibration isolation that is integral with the equipment, such as internal isolators on air handling units.

D. All vibration isolation components (isolators, snubbers, rails, and inertia bases) to be hot-dip galvanized.

## 2.02 VIBRATION ISOLATORS

A. General:

1. Metal parts of vibration-isolation units shall be as follows:

a. Housing: Hot-dipped galvanized outdoors, and inside air handlers and painted indoors. Galvanizing shall meet ASTM salt spray test standards and Federal Test Standard no. 14.

b. Hardware (Washers, Nuts, Bolts, etc.): Galvanized outdoors, and inside air handlers, and cadmium plated indoors.

c. Springs: Neoprene coated outdoors, inside air handlers, and painted indoors.

2. Isolator types are scheduled to establish minimum standards. At the Subcontractor's option, accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevation during installation and initial system filling operations, and similar installation advantages. Accessories shall not degrade the vibration isolation system.

3. Static deflection of isolators are indicated in Vibration Isolation Schedule. Static deflections stated are the minimum acceptable deflection for the mounts under actual load.

4. The use of nested springs or of multiple parallel springs within a single mount is not permitted.

B. Unit FSN (Floor Spring and Neoprene)

1. Spring isolators to be free-standing and laterally stable without housing. Spring diameter shall be not less than 0.8 times the compressed height of the spring at the design load. Springs shall have a minimum additional travel to solid equal to 50

percent of the actual deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately 1. mounts shall have leveling bolts.

2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene. A rectangular bearing plate of appropriate size to load the pad uniformly in the range of 40 to 50 psi shall be provided. A neoprene friction pad and a stainless steel, aluminum, or galvanized steel plate shall be used between the friction pad and the isolator. The isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.

3. Unit FSN isolators shall be one of the following products, or equal:

   a. Type SLF: M.I.

   b. Type FDS: K.N.C.

   c. Type AC or AD: V.M.C.

C. Unit HS (Hanger Spring)

1. Vibration-isolation hangers shall consist of a free-standing laterally stable steel spring set into a neoprene cup, contained within a steel housing. The neoprene cup shall be manufactured with a grommet (or other element) to prevent the hanger rod from contacting the hanger housing. A steel washer shall be provided in the neoprene cup to evenly distribute load onto the neoprene.

2. The plate or washer at the top of the spring shall be welded to the spring. The hanger rod shall be securely fastened to this plate or washer using lock nuts. The hanger rod shall have a diameter not less than 5/8 inch. This design represents a modification to the unit types given below. The modification is intended to limit the side-to-side motion of the hanger rod relative to the hanger casing.

3. Spring diameter and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the housing. Spring elements shall have minimum additional travel to solid equal to 50 percent of the actual deflection.

4. Upper hanger rod attachment shall be made through a neoprene rubber-in-shear element designed to avoid direct contact between the hanger rod and the isolator frame.

5. Springs shall be color coded for ease of identification and removable, for field connection.

6. Unit HS isolators shall be one of the following products or equal:

    a. Type 30N (modified): M.I.

    b. Type SH (modified): K.N.C.

    c. Type RSH (modified): V.M.C.

## 2.03 EQUIPMENT BASES

A. Unit BSF (Base Steel Frame)

1. Steel base frames shall consist of structural steel sections sized, spaced, connected, and cross-connected to form a rigid base which will not twist, deform, or deflect in any manner which will negatively affect the operation of the supported equipment of the vibration-isolation mounts. Frames shall be adequately sized to support basic equipment units and mounts plus associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. The depth of steel frame bases shall be at least 1/10 the longest dimension of the base with a minimum depth of 6 inches (150 mm), but not more than 12 (300 mm) inches. Frame bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.

2. Unit BSF base shall be supplied by the isolator manufacturer and shall be one of the following products or equal:

    a. Type WFSL: M.I.

    b. Type SFB or SRB: K.N.C.

    c. Type WFB: V.M.C.

B. Unit CIB (Concrete Inertia Base)

1. Concrete inertia bases shall be formed of stone-aggregate concrete (150 pounds per cubic foot) and appropriate steel reinforcing cast between perimeter structural steel channels. Inertia bases shall be built to form a rigid base which will not twist, deform, or deflect, in any manner which would negatively affect the operation of the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base depth shall be at least 1/12 the longest dimension of the inertia base but not less than 6 inches (150 mm) and not more than 12 (300 mm) inches. The weight of the inertia base, as a minimum,

shall be 1 to 2 times that of the total weight of the equipment, as scheduled (including the attached piping it is supporting and other applicable loads). Inertia bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.

2. The steel frame and reinforcement are to be supplied by the vibration isolator manufacturer. Concrete shall be provided in the field.

3. Inertia bases used to support vibration-isolated pumps are to be sized to provide support for valves, pipe elbows and suction diffuser.

4. Frame and reinforcement for Unit CIB bases shall be one of the following products or equal:

   a. Type KSL: M.I.

   b. Type CIB-L or CIB-H: K.N.C.

   c. Type WPF: V.M.C.

## 2.04 SNUBBERS

A. Snubbers to limit the vertical and horizontal motion of the isolated equipment shall be fabricated from steel. A neoprene pad, 1/4-inch minimum thickness, shall be affixed at the point of contact. There will be no contact between snubbers and the inertia base or equipment support frame during normal operation. Minimum of one snubber per side, four total, shall be required on each base. Seismic snubbers shall have a minimum of 1.0G ratings and anchorages.

B. Snubbers shall not be finally installed until vibration isolators are in place and adjusted with actual operating loads.

C. Model Z-1225 for installations within the maximum seismic load requirements consistent with the manufacturer's recommendations, and Model Z-1011 for greater seismic load requirements, manufactured by M.I., Model HS-4 manufactured by K.N.C., or equal.

## 2.05 PIPING ISOLATORS

A. Specialty Products Co. Acousto-Plumb isolators for pipe 3/4 inch (20 mm) and smaller, and Trisolator for pipe 1 inch (25 mm) and larger, or equal.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. The Plumbing Subcontractor shall obtain inspection of installation to be covered or enclosed prior to such closure.

B. The Plumbing Subcontractor shall obtain written and/or oral instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices.

C. The Plumbing Subcontractor shall correct, at no additional cost, installations which are deemed defective in workmanship or materials.

D. The Subcontractor shall be responsible for proper operation of systems, minor sub-systems, and services provided under this Section. The Plumbing Subcontractor shall coordinate startup procedures, calibration, and system checkout with Subcontractors involved. Any system operational problems shall be diagnosed. Correctional procedures shall be initiated by the various Subcontractors as required to bring the system into compliance with the design, and the problem shall then be rechecked to verify that the system operates normally. Any remaining difficulties shall be brought to the attention of the Owner.

E. Do not install equipment, ductwork, piping and conduit which makes rigid contact with the structure unless it is allowed by this specification.

F. The Plumbing Subcontractor shall bring to the Owner's attention prior to installation conflicts which will result in unavoidable contact between the building structure and the isolated equipment, piping, etc., described herein, due to inadequate space, etc. Corrective work necessitated by conflicts after installation shall be at the expense of the Plumbing Subcontractor.

G. The Plumbing Subcontractor shall bring to the Owner's attention prior to installation discrepancies between the requirements of this Section and field conditions, changes required due to specific equipment selection, etc. Corrective work necessitated by discrepancies after installation shall be at the expense of the responsible Subcontractor.

H. Resilient Wall, Ceiling, and Floor Penetrations: Provide resilient wall and ceiling penetrations for piping, conduit, ductwork, etc. supported on Type HS of Type FSN isolators. Refer to resilient penetration details on the Drawings.

I. Support vibration isolated ducts, pipes, and equipment directly from structural steel, not the concrete deck.

## 3.02 ISOLATOR INSTALLATION

A. The installation or use of vibration isolators must not cause change of position of equipment, conduit, piping or ducting, which would result in stresses in connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and attached systems in a rigid position during installation, the load shall not be transferred to the isolator until the installation is complete and under full operational load. plumbing, piping, and ducting at mechanical equipment connections is to be fully supported by specified hangers. Mechanical equipment and vibration mounts shall not carry plumbing, piping, or ducting loads. Utilize flexible metal, liquid-tight conduit for electrical connections.

B. Isolation/Absorption Products: The completed installation must be free of vibration and noise. Systems, equipment, or parts which vibrate or generate vibration unduly, or which generate or emit undue noise while in operation shall: 1) be adjusted, repaired or replaced as appropriate to obtain acceptable levels of vibration or noise; or 2) be supported on, or fitted with, suppression or absorption devices or other means, which effectively prevent the transmission of vibration or noise beyond the offending item.

C. Equipment Isolator Installation

1. Use space saver brackets for equipment supported on Type FSN vibration isolators.

2. The minimum operating clearance between the underside of the frame or inertia base and the pad or floor shall be 1 inch.

3. Place the frame in position and support temporarily by shims prior to the installation of the machine or isolators.

4. After the entire system installation is completed and under full operational load, adjust the isolators so that the load is transferred from the shims to the isolators, and that the shims are barely free. Remove the shims.

5. Seismic snubbers shall not be finally installed until vibration isolators are in-place and adjusted with actual operating loads.

D. Isolator Hangers

1. The isolators shall be installed with the isolator hanger box as close as possible to the structure.

2. The isolators shall be suspended from massive beams, never from slab diaphragms between beams.

3. Orientation of isolator assembly including support and load rods shall be within 5 degrees of vertical.

## 3.03 EQUIPMENT ISOLATION

A. Install isolators for fans, chillers, compressors, pumps and other such equipment as shown on Vibration Isolation Schedule or as otherwise required.

B. Approve completed vibration isolation system for isolated equipment.

## 3.04 PIPING ISOLATION

A. Where specifically indicated only, use specified pipe isolation system.

## 3.05 VIBRATION ISOLATION SCHEDULE

| Equipment | Base Type and Weight[1] | Isolator Type | Minimum Static Deflector |
|---|---|---|---|
| Water Heaters | N/A | N/A | N/A |
| In-Line Pumps | N/A | N/A | N/A |
| Base-Mounted Pumps | CIB 1X | FSN | 2 inches (50 mm) |
| Air Compressor | CIB 2X | FSN | 2 inches (50 mm) |
| Boiler Flues | N/A | N/A | N/A |
| Pipes with Water Pressure (PW, HW, HWR, TW) | N/A | Acousto-Plumb and insulate pipes at each partition penetration with 1-inch-thick insulation | N/A |

1X = 1 time the weight of the equipment supported.
2X = 2 times the weight of the equipment supported.
N/A = Not applicable

## 3.06 BALANCING OF ROTATING EQUIPMENT

A. See Section 22 08 00 – Commissioning of Plumbing System.

**END OF SECTION**

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## SECTION 22 05 53
## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents

1. Drawings and general conditions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes

1. Identification of all installed mechanical distribution piping, mechanical equipment and components

2. Cast-in-place concrete

C. Related Sections

1. Section 09 90 00 – Painting for identification painting

2. Section 22 05 00 – Basic Plumbing Requirements

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

3. Refer to General Conditions and Division 01 – General Requirements for the list of applicable regulatory requirements.

4. Refer to Section 22 05 00 – Basic Plumbing Requirements for codes and standards and other general requirements.

B. ASME

1. ASME A13.1 – Scheme for the Identification of Piping Systems

## 1.03 SUBMITTALS

A. Submit under provisions of Section 22 05 00 – Basic Plumbing Requirements for review of materials, Section 01 33 00 – Submittal Procedures, and General Conditions.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Submit valve database for valve tags as per Article 3.05 – STENCILING AND IDENTIFICATION, Paragraph D, Item 3 herein.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. W. H. Brady or Westline products

B. No substitutions

## 2.02 MATERIALS

A. Color coding: ASME A13.1 unless specified otherwise.

B. Plastic nameplates: Laminated two-layer plastic with engraved black letters on light, contrasting background color.

C. Plastic tags: Laminated three-layer (double-sided) plastic with engraved black letters on light, contrasting background color. Tag size at least 1-1/2-inch- (38-mm-) diameter.

D. Stencils: With clean-cut symbols and letters of following size:

| Outside Diameter of Insulation or Pipe | Color Field Length | Letter Height |
|---|---|---|
| 3/4 to 1-1/4 inches (9.5 to 31.7 mm) | 8 inches (200 mm) | 1/2 inch (13 mm) |
| 1-1/2 to 2 inches (38.1 to 50.8 mm) | 8 inches (200 mm) | 3/4 inch (20 mm) |
| 2-1/2 to 2 inches (63.5 to 50.8 mm) | 12 inches (300 mm) | 1-1/4 inch (32 mm) |
| 8 to 10 inches (203.2 to 254 mm) | 24 inches (600 mm) | 2-1/2 inch (64 mm) |

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| Outside Diameter of Insulation or Pipe | Color Field Length | Letter Height |
|---|---|---|
| Over 10 inches (254 mm) | 32 inches (800 mm) | 3 inches (75 mm) |
| Equipment | --- | 2-1/2 inch (64 mm) |

E. Stencil Paint: Semi-gloss enamel in accordance with Section 09 90 00 – Painting.

F. Plastic Pipe Markers: factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

1. Special gases shall be identified using markers with yellow background and black letters, direction arrow, and full chemical names and symbols.

G. Plastic-Tape Pipe Markers: Flexible, vinyl-film tape with pressure-sensitive adhesive backing and printed markings.

## PART 3 – EXECUTION

### 3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive of identification materials.

B. Prepare surfaces in accordance with Section 09 90 00 – Painting for stencil painting.

### 3.02 INSTALLATION

A. Plastic Nameplates: Install with corrosion-resistant mechanical fasteners, or adhesive.

B. Plastic Tags: Install with corrosion-resistant chain.

C. Stencil Painting: Apply in accordance with Section 09 90 00 – Painting.

D. Plastic Pipe Markers: install in accordance with manufacturer's instructions.

E. Plastic-Tape Pipe Markers: install completely around pipe in accordance with manufacturer's instructions.

F. Underground Plastic Pipe Markers: Install 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

## 3.03 IDENTIFICATION SCHEDULE

A. Equipment: identify air-handling units, pumps, heat-transfer equipment, tanks, and water-treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with plastic tags.

B. Controls: identify control panels and major control components outside of panels with plastic nameplates.

C. Valves: identify valves in main and branch piping with tags.

D. Piping: Identify piping, concealed or exposed, with stenciled painting. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not more than 20 feet (6 m) apart on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

E. Ductwork: identify ductwork with stenciled painting. Identify as to air-handling unit number, and area served. Locate identification at air-handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

## 3.04 VALVE DATABASE

A. Provide specified valve database.

## 3.05 STENCILING AND IDENTIFICATION

A. Stencil each piece of new and existing equipment including pumps, fans, tanks, etc., with the equipment tags scheduled on the drawings. Use minimum 2-inch- (50-mm-) high characters.

1. Stencil each duct leaving the mechanical room indicating fan unit, area(s), direction of flow, or room(s) served.

2. Stencil each duct branch leaving an air shaft at each floor with fan number, and identify it as a supply, exhaust, or return duct, and indicate direction of air flow.

B. Post a framed and typewritten schedule of all stencils, pipe markers, valve tags, and lubricants used, with identification, shall be framed and posted in the mechanical equipment room.

C. Identify all pipes with specified markers.

1. Install markers every 10 feet (3 m) on mains, at all branch take-offs and adjacent to valves and cocks.

2. Apply to all exposed pipes, pipes behind removable tile ceiling, pipes in concealed but accessible locations, such as behind access panels and at least once in each room.

3. Install pipe marker using pressure sensitive adhesive in accordance with the manufacturer's directions. The marker shall completely cover the circumference of the pipe and overlap itself.

D. Valve Tags: Provide numbered tags for main valves, branch valves, zone valves, shut-off valves, and balancing valves installed under this Contract, constructed of 18 gauge (1.02 mm) brass, circular, 1-1/4 inches (31.7 mm) in diameter, and with numbers cut in and blackened so as to be plainly discernible. Fasten tags to valve with brass links.

1. Valve numbers not required for valves obviously serving equipment such as air handler coils, reheat coil valves, and miscellaneous drains.

2. On the as-built drawings, indicate the location and number of each tagged valve.

3. Provide a computer file database in a form agreeable to the Owner, describing the valve, number, location, type of service normally “open” or “closed”, specific duty of each tagged valve, and manufacturer and model number.

E. Warning Sign at Fume Exhaust Plenums: Place warning sign on each fume exhaust plenum access - "WARNING. HAZARDOUS ATMOSPHERE INSIDE. USE BREATHING APPARATUS" when breaching containment.

F. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters.

G. Wherever charts, Shop Drawings, etc. refer to specific room numbers, use room numbers that will be provided by the Owner rather than the room numbers indicated on the Drawings.

**END OF SECTION**

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## SECTION 22 07 19
## PLUMBING PIPING INSULATION

### PART 1 – GENERAL

### 1.01 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract apply to this Section.

1. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes

1. Piping insulation

2. Jackets and accessories

C. Related Sections

1. Division 07 – Thermal and Moisture Protection

2. Section 09 90 00 – Painting for painting insulation jacket

3. Section 22 05 00 – Basic Plumbing Requirements

4. Section 22 05 53 – Identification for Plumbing Piping and Equipment

### 1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

3. Refer to General Conditions and Division 01 – General Requirements for the list of applicable regulatory requirements.

4. Refer to Section 22 05 00 – Basic Plumbing Requirements for codes and standards and other general requirements.

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B. ASTM

1. A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

2. B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

3. C195 – Standard Specification for Mineral Fiber Thermal Insulating Cement

4. C196 – Standard Specification for Expanded or Exfoliated Vermiculite Thermal Insulting Cement

5. C449 – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

6. C450 – Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging

7. C534/C534M – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

8. C547 – Standard Specification for Mineral Fiber Pipe Insulation

9. C552 – Standard Specification for Cellular Glass Thermal Insulation

10. C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

11. C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

12. C610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation

13. C921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

14. E84 – Standard Test Method for Surface Burning Characteristics of Building Material.

C. 20-CFR-1910.7 – Definitions and Requirements for A Nationally Recognized Testing Laboratory (NRTL)

D. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems

E. NFPA 255 – Standard Test Method of Surface Burning Characteristics of Building Materials

F. UL 723 – Test for Surface Burning Characteristics of Building Materials

## 1.03 SUBMITTALS

A. Submit under provisions of Section 22 05 00 – Basic Plumbing Requirements for review of materials and General Conditions.

B. Subcontractor shall submit the product description, list of materials and thickness for each service, and at each location.

C. LEED Submittals

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

## 1.04 QUALITY ASSURANCE

A. Subcontractor shall ensure applicator is a company specializing in piping insulation application with at least 3 years of relevant experience.

B. Fire Hazard: Provide insulation, jackets, facings adhesives and accessories acceptable to the State Fire Marshall and meeting the requirements of NFPA 90A. Meet the following hazard classifications stated in accordance with UL 723:

1. Flame-Spread: Maximum 25

2. Fuel Contributed: Maximum 50

3. Smoke Developed: Maximum 50

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Manville Corporation, Certain-Teed, or Owens Corning Fiberglass

B. Armacell (Armaflex Cellucar Insulation) LLC

C. No substitutions

## 2.02 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.

2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.

3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

    a. Class I, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.

    b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

    c. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. See Article 2.05 VAPOR RETARDANTS of this Section.

5. Mineral-Fiber Insulating Cements: Comply with ASTM C195.

6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C196.

7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449/C449M.

B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.

1. Preformed Pipe Insulation without Jacket: Comply with ASTM C552, Type II, Class I.

2. Preformed Pipe Insulation with Jacket: Comply with ASTM C552, Type II, Class 2.

3. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of -75 to 300 deg F. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C450 for dimensions used in performing insulation to cover valves, elbows, tees, and flanges.

## 2.03 FIELD-APPLIED JACKETS

A. General: ASTM C921, Type I, unless otherwise indicated

B. Foil and Paper Jacket: Not acceptable

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20-mil-thick; roll stock ready for shop or field cutting and forming

1. Adhesive: As recommended by insulation material manufacturer

2. PVC Jacket Color: White

3. PVC Jacket Color: Color-code piping jacket as determined by existing conditions

4. Not to be used for outdoor installations

D. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil- (0.75-mm-) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled

2. Adhesive: As recommended by insulation material manufacturer

3. Not to be used for outdoor installations

E. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B209/B209M, 3003 alloy, H-14 temper.

1. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick

2. Moisture Barrier: 1-mil-thick, heat-bonded polyethylene and kraft paper

3. Elbows: Preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket

## 2.04 ACCESSORIES AND ATTACHMENTS

A. Bands: Stainless steel ASTM A666, Type 304, 0.75-inch- (20-mm-) wide, 0.02-inch- (0.050-mm-) thick.

## 2.05 VAPOR RETARDANTS

A. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.06 SEALANTS

A. Joint Sealants

1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

# PART 3 – EXECUTION

## 3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.02 PREPARATION

A. Install materials after piping has been tested and approved.

B. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

## 3.03 GENERAL APPLICATION REQUIREMENTS.

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Refer to schedules at the end of this Section for material, form, jacket, and thickness required for each piping system insulation requirements.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften or otherwise attack insulation or jacket when in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retardant mastic on insulation indicated to receive a vapor retardant.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond the seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retardant integrity, unless otherwise indicated. Refer to special instruction for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retardant is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retardant mastic.

1. Apply insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor retardants are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retardant integrity.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation where vapor retardants are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retardant integrity.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (38 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

4. Exception: Do not staple longitudinal laps on insulation having a vapor retardant.

5. Vapor-Retardant Mastics: Where vapor retardants are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

6. At penetrations in jackets for thermometers and pressure gauges, fill and seal voids with vapor-retardant mastic.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retardant mastic.

2. Apply insulation for exterior applications tightly joined to interior insulation ends.

3. Extend metal jacket for exterior insulation occurring outside of roof flashing at least 2 inches below the top of the roof flashing.

4. Seal sheet metal jacket to roof flashing with vapor-retardant mastic.

Q. Exterior Wall Penetrations: For penetration of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retardant mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions

1. Firestopping and fire-resistive joint sealers are specified in Division 07 – Thermal and Moisture Protection for penetration firestopping.

2. Floor Penetrations: Apply insulation continuously through floor assembly.

3. For insulation with vapor retardants, seal insulation with vapor-retardant mastic where floor supports penetrate vapor retardant.

## 3.04 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.

3. For insulation with factory-applied jackets, secure laps with outward clinches staples at 6 inches o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

3. Cover fittings with heavy PVC covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.

3. Apply insulation to flanges as specified for flange insulation application.

4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

## 3.05 PREFORMED ELASTOMERIC CELLULAR THERMAL INSULATION APPLICAION

A. Apply insulation to straight pipes and tubes as follows:

1. Install pipe insulation by slitting tubular sections and applying onto pipes. Seams and butt joints shall be adhered and sealed using Armaflex 520 adhesive.

2. All edges shall be clean-cut. Rough or jagged edges shall not be permitted.

B. Apply insulation to valves, flanges and fittings as follows:

1. Insulate with the same insulation thickness as the adjacent piping. Seams and butt joints shall be adhered and sealed with Armaflex 520 adhesive.

2. All edges shall be clean-cut. Rough or jagged edges shall not be permitted.

C. Outdoor insulation shall be protected as follows:

1. Furnish PVC jacket and PVC fitting covers or aluminum jackets.

2. All jackets shall have the seams located on the bottom of the pipes.

## 3.06 FIELD-APPLIED JACKET APPLICATION

A. Apply PVC jacket where indicated, with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

B. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel band 12 inches (300 mm) o.c. and at end joints.

C. Insulation and jacket for cold pipes shall include wicks to direct possible condensation to outside the jacket. The product shall be Knauf PermaWick or equal.

D. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with or without vapor barrier, factory-applied or field-applied. Insulate fittings, joints and valves with insulation of like material and

thickness as adjoining pipe, and finish with glass cloth and adhesive. PVC jackets shall be used.

E. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Finish with canvas jacket; size for finish painting. PVC jackets shall be used.

F. Exterior Applications: Provide vapor-barrier jackets. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe and cover with aluminum jacket.

G. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt-impregnated open-mesh glass fabric, with 0.001-inch-thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

## 3.07 FINISHES

A. Paint insulation as specified in Section 09 90 00 – Painting.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

## 3.08 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment.

1. Flexible connectors

2. Vibration control devices

3. Fire-suppression piping

4. Drainage piping located in crawl spaces, unless otherwise indicated

5. Below-grade piping, unless otherwise indicated

6. Chrome-plated pipes and fittings, unless potential for personal injury

7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators

## 3.09 INSULATION APPLICATION SCHEDULE, GENERAL.

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

## 3.10 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Potable Hot Water

1. Operating Temperature: 60 to 140 deg F

2. Insulation Material: Mineral-fiber or elastomeric

3. Insulation Thickness: Apply the following insulation thicknesses:

a. Copper Pipe, Up to 2 Inches: 1 inch

4. Field-Applied Jacket: PVC

5. Vapor Retarder Required: Yes

6. Finish: As specified in Article 3.07 of this Section.

B. Service: Potable Cold Water (Industrial)

1. Operating Temperature: 45 deg F

2. Insulation Material: Mineral-fiber or elastomeric

3. Insulation Thickness: Apply the following insulation thicknesses:

a. Copper Pipe, All Sizes: 1 inch

4. Field-Applied Jacket: PVC

5. Vapor Retarder Required: Yes

6. Finish: As specified in Article 3.07 of this Section.

## 3.11 EXTERIOR INSULATION APPLICATION SCHEDULE

A. This application schedule is for aboveground insulation outside the building.

B. Service: Potable Water

1. Operating Temperature: 60 to 140 deg F

2. Insulation Material: Mineral-fiber or elastomeric

3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Copper pipe, All Sizes: 1 inch

   b. Polypropylene Pipe 1 inch

4. Field-Applied Jacket: Aluminum

5. Vapor Retarder Required: Yes

6. Finish: As specified in Article 3.07 of this Section.

## 3.12 ALTERNATE INSULATION APPLICATION

A. Preformed polyolefin insulation may be used as an alternative to the materials in Article 3.10 and Article 3.11 of this Section.

**END OF SECTION**

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# SECTION 22 08 00
# COMMISSIONING OF PLUMBING SYSTEMS

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. The requirements of this Section apply to all Sections of Division 22.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 75 00 – Checkout and Startup Procedures. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 75 00 – Checkout and Startup Procedures. A Commissioning Agent (CxA) appointed by the Owner will manage the commissioning process.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 01 75 00 – Checkout and Startup Procedures

C. Division 22 – Plumbing

### 1.03 SUMMARY

A. This Section includes requirements for commissioning the facility exterior closure, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 75 00 – Checkout and Startup Procedures.

B. Refer to Section 01 75 00 – Checkout and Startup Procedures for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

### 1.04 DEFINITIONS

A. Refer to Section 01 75 00 – Checkout and Startup Procedures for definitions.

### 1.05 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 22 – Plumbing is part of the construction process. Documentation and testing of these systems in accordance with the requirements of Section 01 75 00 – Checkout and Startup Procedures and Division 22 – Plumbing is required in cooperation with the Owner and the Commissioning Agent.

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B. The facility exterior closure systems commissioning shall include the systems listed in Section 01 75 00 – Checkout and Startup Procedures.

## 1.06 SUBMITTALS

A. The commissioning process requires review of selected submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the Owner prior to forwarding to the Contractor. Refer to Section 01 33 00 – Submittal Procedures for further details.

B. The commissioning process requires submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 75 00 – Checkout and Startup Procedures.

## 1.07 PLUMBING, BUILDING AUTOMATION SYSTEMS, AND TAB WORK

A. The commissioning tasks applicable to the mechanical, building automation systems (BAS) and TAB work of Division 22 – Plumbing are as follows (all references apply to equipment to be commissioned only):

1. Construction and Acceptance Phase Requirements

    a. Submittal data, commissioning documentation, and Operation and Maintenance (O&M) data.

    b. Attend all commissioning meetings.

    c. Provide shop drawings of equipment to be commissioned along with completed & signed Pre-Functional checklists.

    d. Document start-up and functional testing procedures including:

        1) Manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, Owner-contracted tests, fan and pump curves, all factory testing reports, and all warranty information.

    e. Table of contents with listing of all equipment that will be included in the O&M manuals for review and approval.

    f. Specific functional performance test procedures.

    g. Alarm limits to be used during the tests.

    h. Start-up and initial checkout plan using manufacturer’s start-up procedures and the pre-functional checklists for all equipment to be commissioned. Submit to Engineer for review and approval prior to startup. Refer to Section

01 75 00 – Checkout and Startup Procedures for further details on startup plan.

i. Prior to startup and initial checkout process, execute the mechanical pre-functional checklists for all equipment to be commissioned.

j. Perform and clearly document all system operational checkout procedures and completed startup, promptly providing a copy to the Owner as components are completed and systems are debugged and completed.

k. Correct all punch list items before functional testing.

l. Water TAB shall be completed with discrepancies and problems remedied before requesting Owner witnessing functional testing.

m. Functional Performance Tests/Procedures may be used to perform adjustments prior to witnessing by the Engineer and Owner.

n. Complete functional performance testing for specified equipment in Section 01 75 00 – Checkout and Startup Procedures.

B. Assist the Owner in interpreting the monitoring data.

1. Correct deficiencies as interpreted by the Owner, Engineer, and Contractor and retest the equipment prior to Functional Performance Witnessing by the CxA. Coordinate scheduling of Functional Performance Witnessing with the Contractor and Owner.

2. Provide all documentation, plans, reports, notes, output from electronic commissioning tools and other analysis tools to the Owner promptly upon successful Functional Test witnessing.

3. Update O&M manuals according to the Contract Documents.

4. Document specific requirements to maintain the validity of the warranty.

## 1.08 WARRANTY PERIOD

A. Execute seasonal or deferred functional performance testing, witnessed by the Owner.

B. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 GENERAL REQUIREMENTS

A. This Section establishes general requirements pertaining to plumbing commissioning of building systems, equipment and appurtenances.

B. Commissioning is intended to achieve the following specific objectives of the Contract Documents:

1. Verify and document proper installation and design parameters of equipment, systems, and integrated systems.

2. Ensure that operating and maintenance and commissioning documentation requirements are complete.

3. Provide Owner with functional buildings and systems that meet the requirements of the Contract Documents and Owner’s operational requirements at Substantial Completion.

C. The Contractor shall deliver a successful Commissioning process. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents and the specified Owner's operational requirements. During Commissioning, the Contractor shall systematically demonstrate to the Owner that the operable systems are properly performing in strict accordance with the Contract Documents and Owner requirements.

1. Commissioning requires cooperation and involvement of all parties throughout the construction process.

2. Successful Commissioning requires that installation of all building systems complies with Contract Documents requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion, with the exception of deferred tests approved in advance by the Engineer.

3. Commissioning will encompass and coordinate traditionally separate functions of: system documentation, Inspection, Pre-functional Checklists and startup, control system calibration and point-to-point checkout, Testing, Adjusting, and Balancing, Functional Performance Tests, Integrated System Tests, and Contractor demonstration to the Owner. This requires assembling all related documentation into one Commissioning Manual.

4. Interim Reports and Final Commissioning Manual shall be submitted in electronic, fully searchable, portable document format (.pdf) file format for review and approval by the Engineer and the Owner.

D. Certify that plumbing systems, BAS, subsystems, and equipment have been installed, calibrated, and started and operating according to the Contract Documents, manufacturer's specifications, Owner's standards and specifications, and approved Shop Drawings and submittals.

E. Certify that plumbing instrumentation and control systems have been installed and calibrated, that they are operating according to the Contract Documents, Owner's standards and specifications, and approved Shop Drawings and submittals, and that pretest set points have been recorded.

F. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

G. Set systems, subsystems, and equipment into operating modes to be tested according to approved test procedures. Modes required to be tested include normal startup, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.

H. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

I. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

J. Construction Checklists: Prepare and submit detailed construction checklists for Plumbing systems, subsystems, equipment, and components.

K. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Engineer, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Engineer and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.

3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

L. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

M. Include seasonal testing. Complete appropriate initial performance tests and documentation and schedule seasonal tests.

N. Coordinate schedule with and perform the following activities at the direction of Engineer.

O. Comply with construction checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying plumbing systems and equipment.

P. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests

2. Demonstration of a sample of performance tests

3. Commissioning tests

4. Commissioning test demonstrations

Q. Construction Meetings: The Cx Agent shall conducts regular meetings during construction to identify and assist in resolving issues, including, but not limited to, submittal reviews, BAS sequences, construction quality deficiencies, Owner’s standards adherence, receipt of as-built drawings and schedule concerns.

1. Commissioning Construction List tracking shall include a list of items to be resolved, date identified, required action, responsible party and date resolved.

R. Final Cx Report. The Cx Agent shall provide a Final Report within 6 months of building occupancy. Report shall include:

1. Executive Summary

2. Construction List

3. Commissioning checklists

4. BAS as-built drawings

5. O&M Manual

6. TAB report

S. Quality Assurance. Commissioning procedures shall be in accordance with NEBB, ASHRAE, AEE or BCxA. Commissioning agent shall be certified by one of these groups.

## 3.02 CONSTRUCTION INSPECTIONS

A. Commissioning of plumbing systems will require inspection of individual elements of the plumbing systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 75 00 – Checkout and Startup Procedures and the Commissioning Plan to schedule plumbing systems inspections as required to support the Commissioning Process.

## 3.03 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Owner and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 01 75 00 – Checkout and Startup Procedures for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

## 3.04 CONTRACTOR'S TESTS

A. Contractor tests as required by other sections of Division 22 – Plumbing shall be scheduled and documented in accordance with the General Conditions. All testing shall be incorporated into the Project schedule. Contractor shall provide no less than 14 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

## 3.05 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 75 00 – Checkout and Startup Procedures for additional details.

**END OF SECTION**

## SECTION 22 10 14

## FACILITY NATURAL GAS PIPING

### 1.1 DESCRIPTION

A. Fuel gas systems, including piping, equipment and all necessary accessories as designated in this Section. Fuel gas piping for central boiler plants is not included.

B. A complete listing of common acronyms and abbreviations are included on Contract Documents or in Section 22 05 00 – Basic Plumbing Requirements.

### 1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 07 84 00 – Firestopping

C. Section 07 90 00 – Joint Fillers, Sealants and Caulking

D. Section 09 91 00 – Painting

E. Division 22 – Plumbing

### 1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only. .

1. ASME

a. B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300

b. B16.9 – Factory Made Wrought Buttwelding Fittings

c. B16.11 – Forged Fittings, Socket-Welding and Threaded

d. B16.15 – Cast Copper Alloy Threaded Fittings: Classes 125 and 250

e. B16.40 – Manually Operated Thermoplastic Gas Shutoffs and Valves in Distribution Systems

f. B31.8 – Gas Transmission and Distribution Piping Systems

2. ASTM

    a. A47/A47M – Standard Specification for Ferritic Malleable Iron Castings

    b. A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

    c. A536 – Standard Specification for Ductile Iron Castings

    d. A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless-Steel Pipe Nipples

    e. B43 – Standard Specification for Seamless Red Brass Pipe, Standard Sizes

    f. B687 – Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

    g. D2513 – Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

    h. D2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

    i. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

3. AWWA

    a. C203 – Coal-Tar Protective Coatings and Linings for Steel Water Pipes

4. ICC

    a. International Fuel Gas Code (IFGC)

    b. International Plumbing Code (IPC)

5. MSS

    a. SP-72 – Ball Valves with Flanged or Butt-Welding for General Service

    b. SP-110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

6. NACE

    a. SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings

b. SP0490 – Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coating of 250 to 760 µm (10 to 30 mil)

7. NFPA

a. 54 – National Fuel Gas Code

## 1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Manufacturer's Literature and Data: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity

1. Pipe and fittings

2. Valves

3. Strainers

4. All items listed in PART 2 - PRODUCTS.

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

## 1.5 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, approved substitutions and construction revisions shall be in accordance with Section 01 78 23 – Operation and Maintenance Data and Section 01 78 39 – Project Record Documents.

## 1.6 SYSTEM PRESSURE

A. Natural gas systems, unless otherwise noted, are designed and materials and equipment selected to prevent failure under gas pressure of 14 inches water column at downstream side of pressure regulator.

## PART 2 - PRODUCTS

## 2.1 FUEL GAS SERVICE CONNECTIONS TO BUILDING

A. From inside face of exterior wall to a distance of approximately 5 feet outside of building.

B. Pipe: Black steel, ASTM A53/A53M, Schedule 40. Shop-applied pipe coating shall be one of the following types:

1. Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous glass mat in accordance with AWWA C203.

C. Procedure for Holiday Inspections: Holiday inspection shall be conducted on all coatings to determine the presence and number of discontinuities in those coatings using a Tinker & Rasor model AP/W Holiday Detector or equal. Holiday inspection shall be performed in a manner spelled out in the Tinker & Rasor operating instructions and at a voltage level recommended by the coating manufacturer or applicable NACE standard such as SP0274 or SP0490 in the case thermosetting epoxy coating. Holiday detectors shall be calibrated and supplied with a certificate of calibration from the factory. A calibration of the Holiday Detector shall be performed once every 6 months to verify output voltages are true and correct.

D. Steel Fittings

1. Butt weld fittings, wrought steel, ASME B16.9

2. Socket weld and threaded fittings forged steel, ASME B16.11

3. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47/A47M, Grade 32510), or steel (ASTM A53/A53M, Type F or Type E or S, Grade B).

E. Steel Joints: Welded, ASME B31.8

## 2.2 FUEL GAS PIPING ABOVE GROUND

A. Pipe: Black steel, ASTM A53/A53M, Schedule 40

B. Nipples: Steel, ASTM A733, Schedule 40

C. Fittings

1. Sizes 2-inch and Smaller: ASME B16.3 threaded malleable iron

2. Over 2-inch and Up to 4-inch: ASME B16.11 socket welded

3. Over 4-inch: ASME B16.9 butt welded

D. Joints: Provide welded or threaded joints.

E. Threaded Metallic Joints: Threaded joints in metallic pipe shall have tapered threads evenly cut. Metal screwed pipe joints shall be made leak-tight by applying Rector Seal No. 5 pipe thread sealant to all threaded joints. Care must be taken to prevent the pipe dope compound from getting inside the internal pipeline. Teflon tape type sealant is prohibited.

## 2.3 EXPOSED FUEL GAS PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed fuel gas piping connecting fixtures, casework, cabinets, and equipment when not concealed by apron including those furnished by the Owner or specified in other Sections.

1. Pipe: ASTM B43, standard weight

2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish, (125 and 250)

3. Nipples: ASTM B687, chromium-plated

4. Unions 2 inches and smaller shall be per MSS SP-72, MSS SP-110, brass or bronze threaded with chrome finish. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.

5. Valves: MSS SP-72, MSS SP-110, brass or bronze with chrome finish

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 90 00 - Painting.

## 2.4 VALVES

A. Ball Valve: Bronze body, rated for 150 psig at 365 degrees F, reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services

B. Gas Vent Cocks: Type 701: Bronze body, tee handle, rated for 30 psig at 100 degrees F, ground plug, rated for tight shut-off on fuel gas service

## 2.5 WATERPROOFING

A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on Drawings.

## 2.6 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.

C. Body: Smaller than 3 inches, brass or bronze; 3 inches and larger, cast iron or semi-steel.

## 2.7 DIELECTRIC FITTINGS

A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

## 2.8 GAS EQUIPMENT CONNECTORS

A. Flexible connectors with Teflon core, interlocked galvanized steel protective casing, AGA certified design.

## 2.9 FUEL GAS PIPING BELOW GROUND

A. Thermoplastic (Polyethylene): Polyethylene (PE) pipe and heat fusion fittings shall conform to ASTM D2513, SDR 11, Grades 2306,3306 and 3408 and manufactured for 125 psig working pressure. Pipe and fittings shall have heat fusion joints PE pipe and fitting materials for heat fusion shall be compatible to ensure uniform melting and a proper bond.

B. Fittings

1. Socket Fusion Fittings: ASTM D2683

2. Butt Fusion Fittings: ASTM D3261, molded and matching pipe dimensions

3. Stab or push-on type fittings are not acceptable.

C. Risers: Manufacturer's standard anodeless type riser, transition from plastic to steel pipe with fusion bonded epoxy coating. Inlet connection socket or butt weld or swaged

gas-tight construction with O-ring seals, metal insert, and protective sleeve. Outlet or above ground connection end shall be threaded or flanged. Riser shall comply with ASTM A53/A53M, Type F and E, Grade A, Schedule 40.

D. Polyethylene ball valves, ASME B16.40 shall be manufactured and rated for underground gas service. Operating pressure to 125 psig (SDR 9.3). Valve shall be maintenance and corrosion free. Polyethylene valves shall be full port opening type. Valves shall be wrench operated. Wrench operated valves shall have a 2-inch-square adaptor securely fastened to the valve stem. Polyethylene valves shall be installed by butt fusion method.

## 2.10 VALVE BOXES

A. Provide each valve on buried piping with a plastic or cast iron valve box of a size suitable for the valve. Valve box shall have a round cover with the word "Gas" cast on it. A metal tag or label shall be installed on top or inside of each valve box lid. The tag shall designate the appropriate location number, valve size, and other pertinent information. Each cast iron box shall be given a heavy coat of bituminous paint. Provide adjustable box extensions of length required for depth of buried valve.

## 2.11 PRESSURE REGULATORS

A. Gas main regulators

1. Manufacturers

    a. Equimeter

    b. American Meter

    c. Sensus

2. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.

    a. Comply with ANSI Z21.80.

    b. Temperature Range: -20 to 150 degrees F

    c. Body: Cast iron with neoprene gasket

    d. Spring Case, Lower Diaphragm Casing, Union Ring, Seat Ring and Disk Holder: Aluminum

    e. Disk, Diaphragm and O-Ring: Nitrile

    f. Minimum Inlet Pressure: 5 psig

g. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

B. Service Regulators

1. Manufacturers

a. Equimeter

b. American Meter

c. Sensus

2. Body and Diaphragm Case: Cast iron or aluminum

3. Springs: Zinc plated steel, interchangeable

4. Diaphragm Plate: Zinc plated steel

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion and deformation at the valve port

6. Orifice: Aluminum, interchangeable

7. Seal Plug: Ultraviolet-stabilized, mineral filled nylon

8. Single port, self contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, not to exceed 150 percent of design discharge pressure at shut off.

10. Overpressure Protection Device: Factory mounted on pressure regulator

11. Atmospheric Vent: factory or field installed, stainless steel screen in opening if not connected to vent piping

12. Maximum Inlet Pressure: 60 psig

## 2.12 PRESSURE RELIEF VALVES

A. Manufacturers

1. Fisher

2. American Meter

3. Or Approved Equal

B. Product Description: Spring loaded type relief valve

1. Body: Aluminum

2. Diaphragm: Nitrile

3. Orifice: Stainless steel

4. Maximum Operating Temperature: 150 degrees F

5. Outlet or Vent Connection: Same size as inlet connection

## 2.13 UNDERGROUND LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## 2.14 VALVES

A. Manual Shut-off Valves Inside Building

1. Manufacturer

a. Nordstrom

b. Fisher

c. Grinnel

2. General Requirements for Metallic Valves, 2 Inches and Smaller: Comply with ASME B16.33.

a. CWP Rating: 125 psig

b. Threaded Ends: Comply with ASME B1.20.1.

c. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

d. Tamperproof Feature: Locking feature for valves where required.

e. Listing: Listed and labeled by NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller

f. Service Mark: Valves 1-1/4 inches to 2 inches shall have initials “WOG” permanently marked on valve body.

3. General Requirements for Metallic Valves, 2 Inches and Larger: Comply with ASME B16.38.

    a. CWP Rating: 125 psig

    b. Tamperproof Feature: Locking feature for valves where required.

    c. Service Mark: Valves shall have initials “WOG” permanently marked on valve body.

    d. 2-1/2 Inches to 4 Inches: Flanged cast iron body lubricated plug type, 175 psig WOC

    e. 6 Inches and Larger: Flanged cast iron body lubricated tapered plug type, 200 psig WOG, worm gear operated.

4. Provide two wrenches for each valve size used.

B. Ball Valves

1. Manufacturer

    a. Contromatics

    b. Conbraco

    c. NIBCO

2. On local branches 3 inches and smaller, provide threaded three piece full port wafer type ball valve with bronze body, ball stem, Teflon seats and level handles, 300 psig WOG.

C. Two Piece, Full Port Bronze Ball Valves with Bronze Trim: MSS SP-110

1. 2 Inches and Smaller; Threaded brass ball valves with full port TFE seals and blowout proof stem, 600 psig WOG

2. Manufacturers

    a. Brasscraft

    b. Conbraco

    c. NIBCO

    d. Body: Bronze, complying with ASTM B584

    e. Ball: Chrome plated bronze

f. Stem: Bronze; blowout proof

g. Seats: Reinforced TFE, blowout proof

h. Packing: Threaded body packnut design with adjustable stem packing

i. Ends: Threaded, flared or socket

j. CWP Rating: 600 psig

k. Listing: Valves 1 inch and smaller shall be listed and labeled by NRTL acceptable to authorities having jurisdiction.

l. Service: Suitable for natural gas service with WOG indicated on valve body

D. Bronze Plug Valve per MSS SP-78

1. Manufacturer

a. Hammond

b. Lee Brass Company

c. NIBCO

2. Body: Bronze, complying with ASTM B584

3. Plug: Bronze

4. Ends: Threaded, socket or flanged

5. Operator: Square head or lug type with tamperproof feature where indicated

6. Pressure Class: 125 psig

7. Listing: Valves 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

8. Service: Suitable for natural gas service with WOG indicated on valve body

E. Cast Iron, Non-Lubricated Plug Valves per MSS SP-78

1. Manufacturer

a. McDonald

b. Mueller

c. Xomox Corporation

2. Body: Cast iron, complying to ASTM A126, Class B

3. Plug: Bronze or nickel plated cast iron

4. Seat: Coated with thermoplastic

5. Stem Seal: Compatible with natural gas

6. Ends: Threaded or flanged

7. Operator: Square head or lug type with tamperproof feature where indicated

8. Pressure Class: 125 psig

9. Listing: Valves 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural gas service with WOG indicated on valve body

F. Cast Lubricated Plug Valve inside Building

1. 2 Inch and Smaller: cast iron body, threaded, equal to Nordstrom Valves Figure 114

2. 2-1/2 Inches and Larger: Flanged cast iron body lubricated tapered plug type, 175 psig WOG, equal to Nordstrom Valves Figure 115

3. 6 inch and Larger: Flanged cast iron body lubricated tapered plug type, 200 psig WOG, worm gear operated, equal to Nordstrom Valves Figure 165

4. Valves 2-1/2 inch and larger shall be flanged.

5. Provide two wrenches for each valve size used.

6. Gas Cocks

    a. Gas cocks shall be for use with manual gas shut-off valves at each piece of gas burning equipment; shall be of the plug type, bronze construction with check, nut and washer bottom and tee handle.

    b. Gas cocks shall be A. Y. McDonald Mfg Figure 10596 or Conbraco Industries Series 52.

G. Underground Valves

1. For steel piping, provide welding end steel body tapered plug type with iron plug high head extension.

    a. 2 inch to 4 inch: 200 psig WOG, equal to Nordstrom Figure 1943

b. 6 inch and Larger: 275 psig WOG, equal to Nordstrom Figure 4185

2. For polyethylene piping, provide polyethylene body ball valve with butt fusion ends, rated for natural gas service, 125 psig WOG complying with ANSI B16.40, ASTM D2513.

   a. Body: PE 4710/3408, high density

   b. Ball: 2 inch and smaller, acetal; 2-1/2 inches and larger, polypropylene

   c. Seat Retainer: 2 inch and smaller, acetal; 2-1/2 inches and larger, polypropylene

   d. Seat: Buna-N

   e. Stem: 2 inch and smaller, stainless steel; 2-1/2 inches and larger, Acetal

   f. Ground Water Seal: Neoprene

   g. Wrench Adapter: 2 inch and smaller: Acetal; 2-1/2 inch and larger: Polypropylene

## 2.15 EMERGENCY GAS SAFETY SHUT-OFF VALVE WITH EARTHQUAKE SENSOR

A. Permits remote shut-off of fuel gas flow to natural gas system.

B. Type: Manually opened, electrically held open, automatic closing upon power interruption. Pneumatic operator is prohibited.

C. Performance: Shall shut bubble tight within one second after power interruption. Refer to the drawings for pressure, flow, and valve size requirements.

D. Service: Natural gas and LP gas

E. Manufacturer

   1. Pacific Seismic Products

   2. Quake Defense

   3. Strand Earthquake

F. Construction: UL listed, FM approved, rated for 125-psig, ASME flanged ends for pipe sizes above 2 inches, threaded ends for pipe sizes 2 inches and smaller. Cast iron, cast steel or bronze body, open and shut indicator. Valves for LP gas service shall be rated at 250 psig.

G. Earthquake Sensor: Mechanical device which automatically breaks 120V electrical circuit to safety shut off valve when earthquake occurs allowing valve to automatically close. UL listed and shall comply with State of California Standard Codes (Part 12 Title

24 CAC). Valve shall close within 5 seconds after sensor is subjected to horizontal sinusoidal oscillation having a peak acceleration of 0.3g and a period of 0.4 seconds. The valve shall not shut off when the sensor is subjected for 5 seconds to horizontal, sinusoidal oscillations having: a peak acceleration of 0.4g with a period of 0.1 second; a peak acceleration of 0.08g with a period of 0.4 second; peak acceleration of 0.08g with a period of 1.0 second. Sensor shall be corrosion-resistant for outside location.

## 2.16 SLEEVES

A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends

B. Cast Iron Pipe Sleeves: Cast or fabricated wall pipe, equivalent to ductile iron pipe, with plain ends and integral waterstop, unless otherwise noted

## 2.17 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve

1. Manufacturer

    a. Advance Products & Systems

    b. Calpico Inc.

    c. Metraflex Company

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.

3. Pressure Plates: Carbon steel

4. Connecting Bolts and Nuts: carbon steel with corrosion resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## 2.18 PRESSURE GAUGES

A. 4-1/2-inch-diameter, black enamel coated steel case ring with shatterproof glass, 1/2-inch bronze bellows with brass socket, blow out on back of case, 1/4-inch bottom outlet connection, similar to Trerice No. 860 or Weksler Instruments No. BL14-PWE4-LWXX with 0 to 27 inches of water column dial, brass pressure snubber and brass tee handle cock.

## 2.19 CATHODIC PROTECTION

1. Provide a complete electrically isolated, cathodic protection system for the entire length of the underground metallic gas line, including all components, suitable for temperatures and pressures involved.

2. Prior to installation, conduct a corrosion site survey using a qualified corrosion engineer to evaluate soil conditions and establish system requirements.

3. System shall be the sacrificial magnesium anode type with 17-pound anodes, spacing based upon soil resistivity readings, with a maximum spacing of 300 feet. Pack anodes in permeable cloth bag in backfill: 75% ground hydrated gypsum, 20% powdered Wyoming bentonite, 5% anhydrous sodium sulfate.

4. Magnesium anodes shall be high current type with magnesium wall having the following composition:

    a. Aluminum: 5.3 to 6.7%

    b. Manganese: 0.15% minimum

    c. Zinc: 2.5 to 3.5%

    d. Silicone: 0.3% maximum

    e. Copper: 0.02% maximum

    f. Nickel: 0.003% maximum

    g. Iron: 0.03% maximum

    h. Magnesium: Remaining

5. Anodes shall be cast with perforated galvanized steel strap core. One end of anode shall be recessed so one end of the strap is accessible for lead wire connection. Anode lead wires shall be 25 feet long, silver soldered to strap core and with a minimum one turn of wire at connection. Fill anode recess connection with electrical potting compound, Conductors shall be No. 12 AWG Type TW copper wire.

6. Connectors shall be brazing type elements for mechanically bonding conductors to steel pipe. Moisture proof all connections to piping. Splices shall be made with split bolt compression connectors and suitable protection tape.

7. For pipe installed in sleeves, provide insulators, equal to Maloney Model 57, spaced 10 feet on centers, installed in accordance with manufacturer’s recommendations. Provide insulating coupling for pipe penetrating building wall.

8. Provide test stations housed in electrical conduit terminated in cast iron, waterproof junction boxes at ground surface. Embed in 12 inches x 12 inches by 6 inches concrete marker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. General: Comply with the ICC IFGC, ICC IPC and the following:

1. Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Owner or specified in other Sections.

2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

3. All pipe runs shall be laid out to avoid interference with other work.

4. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.

5. Install union and shut-off valve on pressure piping at connections to equipment.

6. Pipe Hangers, Supports and Accessories

    a. All piping shall be supported per the ICC IFGC.

    b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with red lead or zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

    c. Floor, Wall and Ceiling Plates, Supports, Hangers

        1) Solid or split unplated cast iron, chrome plated in finished areas

        2) All plates shall be provided with set screws.

        3) Pipe Hangers: Height adjustable clevis type

        4) Adjustable Floor Rests and Base Flanges: Steel

        5) Concrete Inserts: "Universal" or continuous slotted type

6) Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place

7) Riser Clamps: Malleable iron or steel

8) Rollers: Cast iron

9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.

10) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories

7. Install cast chrome plated escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

8. Penetrations

   a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00 – Firestopping. Completely fill and seal clearances between piping and openings with the firestopping materials.

   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 90 00 – Joint Fillers, Sealants and Caulking.

B. Fuel gas piping shall conform to the following:

1. Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.

2. Provide fuel gas piping with plugged drip pockets at low points.

3. Seismic Data: Install automatic shutoff valve (earthquake valve) on discharge side of meter. Valve shall positively shut off supply of gas in case of pressure failure, remain shut off until manually reopened, and be provided with outside adjustment for reset.

C. If an installation is unsatisfactory to the Engineer, the Contractor shall correct the installation at no additional cost or time to the Owner.

## 3.2 CLEANING OF SYSTEM AFTER INSTALLATION

A. Clean all piping systems to remove all dirt, coatings and debris. Remove all valves, controls etc. and reinstall after piping system has been cleaned.

## 3.3 TESTS

A. General: Test system either in its entirety or in sections after system is installed or cleaned.

B. Test shall be made in accordance with Section 406 of the IFGC. The system shall be tested at a minimum of 1.5 times maximum working pressure, but not less than 15 psig gauge).

C. System Purging: After completing pressure tests, and before testing a gas-contaminated line, purge line with nitrogen at junction with main line to remove all air and gas. Clear completed line by attaching a test pilot fixture at capped stub-in line at building location and let gas flow until test pilot ignites. Procedures shall conform to NFPA 54 and ASME B31.8.

## 3.4 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Owner.

**END OF SECTION**

# SECTION 22 11 13
# FACILITY WATER DISTRIBUTION PIPING

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this Section.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 00 – Basic Plumbing Requirements.

### 1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

C. Section 01 75 00 – Checkout and Startup Procedures

D. Section 07 84 00 – Firestopping

E. Section 07 90 00 – Joint Fillers, Sealants and Caulking

F. Section 09 90 00 – Painting

G. Section 22 05 00 – Basic Plumbing Requirements

H. Section 22 07 19 – Plumbing Piping Insulation

I. Section 22 08 00 – Commissioning of Plumbing Systems

### 1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASME

1. A13.1 – Scheme for Identification of Piping Systems

2. B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300

3. B16.9 – Factory-Made Wrought Buttwelding Fittings

4. B16.11 – Forged Fittings, Socket-Welding and Threaded

12-03-2024

5. B16.12 – Cast Iron Threaded Drainage Fittings

6. B16.15 – Cast Copper Alloy Threaded Fittings: Classes 125 and 250

7. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings

8. B16.22 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

9. B16.24 – Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

10. B16.51 – Copper and Copper Alloy Press-Connect Fittings

11. ASME Boiler and Pressure Vessel Code

12. BPVC Section IX-2015 Welding, Brazing, and Fusing Qualifications

C. ASSE

1. 1010-2004 – Performance Requirements for Water Hammer Arresters

D. ASTM

1. A47/A47M – Standard Specification for Ferritic Malleable Iron Castings

2. A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3. A183 – Standard Specification for Carbon Steel Track Bolts and Nuts

4. A269/A269M – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

5. A312/A312M – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

6. A403/A403M – Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

7. A536 – Standard Specification for Ductile Iron Castings

8. A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

9. B32 – Standard Specification for Solder Metal

10. B43 – Standard Specification for Seamless Red Brass Pipe, Standard Sizes

11. B61 – Standard Specification for Steam or Valve Bronze Castings

12. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

13. B75/B75M – Standard Specification for Seamless Copper Tube

14. B88 – Standard Specification for Seamless Copper Water Tube

15. B584 – Standard Specification for Copper Alloy Sand Castings for General Applications

16. B687 – Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

17. C919 – Standard Practice for Use of Sealants in Acoustical Applications

18. D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

19. D2000 –Standard Classification System for Rubber Products in Automotive Applications

20. D2564 – Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

21. D2657 – Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

22. D2765 – Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics

23. D6394 – Specification for Sulfone Plastics (SP)

24. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

25. E119 – Standard Test Methods for Fire Tests of Building Construction and Materials

26. E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops

27. F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing

28. F877 – Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

29. F1960 – Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Crosslinked Polyethylene (PEX) Tubing

30. D2855 – Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

31. D4101-2014 – Standard Specification for Polypropylene Injection and Extrusion Materials

32. E1120-2008 – Standard Specification for Liquid Chlorine

33. E1229-2008 – Standard Specification for Calcium Hypochlorite

34. F2389-2010 – Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

35. F2620-2013 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

36. F2769-2014 – Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

E. AWWA

1. C110 – Ductile-Iron and Gray-Iron Fittings

2. C151 – Ductile Iron Pipe, Centrifugally Cast

3. C153 – Ductile-Iron Compact Fittings

4. C203 – Coal-Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot Applied

5. C213 – Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

6. C651 – Disinfecting Water Mains

F. AWS

1. A5.8M/A5.8-AMD1 – Specification for Filler Metals for Brazing and Braze Welding

G. ICC

1. IPC – International Plumbing Code

H. MSS

1. SP-58 – Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

2. SP-72 – Ball Valves with Flanged or Butt-Welding Ends for General Service

3. SP-110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

I. NSF

1. 14-2015 – Plastics Piping System Components and Related Materials

2. 61-2014a – Drinking Water System Components – Health Effects

3. 372-2011 – Drinking Water System Components – Lead Content

J. PDI

1. PDI-WH 201-2010 – Water Hammer Arrestors

## 1.04 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. All items listed in PART 2 – PRODUCTS.

C. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

## 1.05 QUALITY ASSURANCE

A. A certificate shall be submitted prior to welding of steel piping showing the Welder’s certification. The certificate shall be current and no more than 1 year old. Welder’s qualifications shall be in accordance with ASME BPVC Section IX.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.

C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

## 1.06 SPARE PARTS

A. For mechanical press-connect fittings, provide tools required for each pipe size used at the facility.

## 1.07 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions per Section 01 78 39 – Project Record Documents.

# PART 2 – PRODUCTS

## 2.01 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

## 2.02 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B88, Type K (ASTM B 88M, Type A, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

2. Copper, Pressure-Seal Fittings

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Viega; Plumbing & Heating Systems

2) Nibco

3) Mueller

c. NPS 2-Inch and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end

d. NPS 2-1/2-Inch to NPS 4-Inch: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end

B. Hard Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) water tube, drawn temper

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

2. Copper, Pressure-Seal Fittings

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Viega; Plumbing & Heating Systems

2) Nibco

3) Mueller

c. NPS 2-Inch and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

d. NPS 2-1/2-Inch to NPS 4-Inch: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## 2.03 PVC PIPE AND FITTINGS

A. PVC, Schedule 80 Pipe: ASTM D1785

1. PVC, Schedule 80 Socket Fittings: ASTM D2467

2. PVC, Schedule 80 Threaded Fittings: ASTM D2464

B. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end

1. Comply with UL 1285 for fire-service mains if indicated.

2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern

a. Gaskets: AWWA C111, rubber

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts

## 2.04 CPVC PIPE AND FITTINGS

A. CPVC Schedule 80 Pipe: ASTM F441/F441M

1. CPVC Schedule 80 Fittings: ASTM F438, socket type.

2. CPVC Schedule 80 Fittings: ASTM F439, socket, ASTM F437, threaded, ASTM F439, socket type or ASTM F437, threaded type

## 2.05 PEX PIPE AND FITTINGS

A. PEX-a (Engel-method crosslinked polyethylene) piping: ASTM F876 and F877 (CAN/CSA-B137.5) by Uponor

B. PEX-a Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2-inch through 3-inch NPS): ASTM F1960 cold-expansion fitting manufactured from the following material types:

1. UNS No. C69300 lead-free (LF) brass

2. UNS No. C27453 lead-free (LF) brass

3. 20% Glass-filled Polysulfone as specified in ASTM D6394

4. Unreinforced Polysulfone (Group 01, Class 1, Grade 2) as specified in ASTM D6394

5. Polyphenylsulfone (Group 03, Class 1, Grade 2) as specified in ASTM D6394

6. Blend of polyphenylsulfone (55-80%) and unreinforced Polysulfone (REM.) as specified in ASTM D6394

7. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

C. Pre-Sleeved Piping (1/2-inch (16-mm) through 3/4-inch (20-mm) NPS): PEX-a piping, with a high-density polyethylene (HDPE) corrugated sleeve

D. Pre-Insulated Piping (1/2-inch (16-mm) through 2-inch (50-mm) NPS): PEX-a piping, with a closed-cell polyethylene foam insulation

E. Multi-Port Tees: Multiple-outlet fitting complying with ASTM F877 (CAN/CSA B137.5); with ASTM F1960 inlets and outlets

1. Engineered polymer branch multi-port tee

2. Engineered polymer flow-through multi-port tee

3. Engineered polymer commercial branch multi-port tee

4. Engineered polymer commercial branch multi-port elbow

5. Engineered polymer commercial flow-through multi-port tee

F. Manifolds: Multiple-outlet assembly complying with ASTM F877 (CAN/CSA B137.5); with ASTM F1960 outlets

1. Engineered polymer valved manifold

2. Engineered polymer valveless manifold

3. Lead - free copper branch manifold

4. Lead-free copper valved manifold

## 2.06 TRAP PRIMER WATER PIPING

A. Pipe: Copper tube, ASTM B88, type K, hard drawn

B. Fittings: Bronze castings conforming to ASME B16.18 solder joints

C. Solder: ASTM B32 alloy type Sb5. Provide non-corrosive flux.

## 2.07 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on Drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket

C. Body: Less than 3 inches, brass or bronze; 3 inches and greater, cast iron or semi-steel

## 2.08 DIELECTRIC FITTINGS

A. Provide dielectric couplings or unions between pipe of dissimilar metals and below grade and above metal piping.

## 2.09 STERILIZATION CHEMICALS

A. Hypochlorite: ASTM E1120

B. Liquid Chlorine: ASTM E1229

## 2.10 WATER HAMMER ARRESTER

A. Closed copper tube chamber with permanently sealed 60-psig air charge above a double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA-approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:

1. All solenoid valves

2. All groups of two or more flush valves

3. All quick opening or closing valves

4. All medical washing equipment

## 2.11 TRANSITION FITTINGS

A. PEX-to-Metal Transition Fittings

1. Manufacturers: Provide fittings from the same manufacturer of the piping.

2. PEX-a to Threaded Brass Transition: One-piece brass fitting with male or female threaded adapter and ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring

3. PEX-a to Brass Sweat Transition: One-piece brass fitting with sweat adapter and ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring

4. PEX-a to Flange Transition: Two-piece fitting with one steel flange conforming to ASME B16.5 and one lead free brass adapter conforming to ASTM F1960

5. PEX-a to Groove Transition: One-piece lead free brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring

6. PEX-a to Water Meter Transition: Two-piece fitting with one NPSM union thread and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring

7. PEX-a to Copper Press Transition: One-piece lead free brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring

B. PEX-to-Thermoplastic Transition Fittings

1. PEX-a to CPVC Transition: Thermoplastic fitting with one spigot or socket end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring

## 2.12 CORROSION RESISTANT COATING

A. All copper pipe shall receive a corrosion resistant coating. For piping that receives insulation, the coating shall be applied and allowed to cure per the manufacturer's instructions prior to insulating.

B. Coating shall be a field-applied Bronz-Glow's SPC-Clear coating, Incralac or approved equal. The coating shall be specifically listed for use on copper pipe for the protection from corrosion due to hydrogen sulfide and shall be UV-resistant.

## 2.13 SOLDER AND FLUX FOR POTABLE WATER SYSTEMS

A. Solder and flux for water distribution systems intended for human consumption shall conform to NSF-61. Solder shall be certified to NSF-61.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Owner or specified in other sections.

2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.

3. All pipe runs shall be laid out to avoid interference with other work/trades.

4. Install union and shut-off valve on pressure piping at connections to equipment.

5. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

6. Penetrations

   a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00 – Firestopping. Completely fill and seal clearances between raceways and openings with the firestopping materials.

   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 90 00 – Joint Fillers, Sealants and Caulking. Bio-based materials shall be utilized when possible.

   c. Acoustical Sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.

7. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. Ensure the tube is completely inserted to the fitting stop (appropriate depth) and squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.

B. Domestic water piping shall conform to the following:

1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.

2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

C. Corrosion Resistant Coating

1. All copper pipes shall receive a corrosion-resistant coating. For piping that receives insulation, the coating shall be applied and allowed to cure per the manufacturer's instructions prior to insulating.

2. Coating shall be a field-applied Bronz-Glow's SPC-Clear coating, Incralac or approved equal. The coating shall be specifically listed for use on copper pipe for the protection from corrosion due to hydrogen sulfide and shall be UV-resistant.

## 3.02 PIPING SCHEDULE

A. Underground water-service piping NPS 3/4-inch to NPS 3-inch shall be any of the following:

1. Soft copper tube, ASTM B88, Type K (ASTM B88M, Type A); wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints

2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints

3. PEX-a, cross linked polyethylene pipe with cold expansion fittings

B. Water meter box water service piping NPS 3/4-inch to NPS 2-inch shall be same as underground water-service piping.

C. Aboveground water service piping NPS 3/4-inch to NPS 3-inch shall be any of the following:

1. Hard copper tube, ASTM B88, Type K (ASTM B88M, Type A); wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints

2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints. PVC shall be limited to water service with temperatures below 100 degrees F.

3. CPVC, Schedule 80 pipe; CPVC, Schedule 80 socket fittings; and solvent-cemented joints

4. NPS 1-inch to NPS 2-inch PEX with cold expansion joints.

## 3.03 TESTS

A. General: Test system either in its entirety or in sections. Submit testing plan to Engineer 10 working days prior to test date.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psig gauge for 2 hours. No decrease in pressure is allowed. Provide a pressure gauge with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1-psig increments.

C. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

D. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

## 3.04 STERILIZATION

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.

B. Use liquid chlorine or hypochlorite for sterilization.

**END OF SECTION**

## SECTION 22 11 19
## DOMESTIC WATER PIPING SPECIALTIES

### PART 1 – GENERAL

### 1.01 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers
2. Backflow preventers
3. Balancing valves
4. Strainers
5. Outlet boxes
6. Hose bibbs
7. Wall hydrants
8. Drain valves
9. Water hammer arresters
10. Air vents
11. Trap-seal primer valves
12. Stainless steel hose reel

B. Related Sections include the following:

1. Section 22 05 19 – Meters and Gauges for Plumbing Piping for thermometers, pressure gauges, and flow meters in domestic water piping

### 1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

### 1.03 SUBMITTALS

A. Product Data: For each type of product indicated

12-03-2024

B. Shop Drawings: Diagram power, signal, and control wiring

C. Field quality-control test reports

D. Operation and Maintenance data

## 1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance

1. Comply with NSF 14 – Plastics Piping Components and Related Materials for plastic domestic water piping components.

2. Comply with NSF 61 – Drinking Water System Components – Health Effects, Sections 1 through 9.

# PART 2 – PRODUCTS

## 2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers

1. Manufacturers

a. Conbraco Industries, Inc.

b. FEBCO; SPX Valves & Controls

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001

3. Size: NPS 1/4-inch to NPS 3-inch, as required to match connected piping

4. Body: Bronze

5. Inlet and Outlet Connections: Threaded

6. Finish: Chrome plated

B. Hose-Connection Vacuum Breakers

1. Manufacturers

a. Conbraco Industries, Inc.

b. MIFAB, Inc.

c. Watts Industries, Inc.; Water Products Div.

d. Woodford Manufacturing Company

e. Zurn Plumbing Products Group

2. Standard: ASSE 1011

3. Body: Bronze, nonremovable, with manual drain

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7

5. Finish: Chrome or rough bronze

C. Pressure Vacuum Breakers

1. Manufacturers

a. Conbraco Industries, Inc.

b. FEBCO; SPX Valves & Controls

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020

3. Operation: Continuous-pressure applications

4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range

5. Accessories

a. Valves: Ball type, on inlet

## 2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers

1. Manufacturers

a. Conbraco Industries, Inc.

b. FEBCO; SPX Valves & Controls

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013

3. Operation: Continuous-pressure applications

4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range

5. Body: Bronze for NPS 2-inch and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA-approved or steel with interior lining complying with AWWA C550 or that is FDA-approved for NPS 2-1/2-inch and larger

6. End Connections: Threaded for NPS 2-inch and smaller, flanged for NPS 2-1/2-inch and larger

7. Configuration: Designed for horizontal, straight through flow

8. Accessories

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2-inch and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2-inch and larger

b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection

## 2.03 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Pressure Rating: 125 psig minimum, unless otherwise indicated

2. Body: Bronze for NPS 2-inch and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2-inch and larger

3. End Connections: Threaded for NPS 2-inch and smaller, flanged for NPS 2-1/2-inch and larger

4. Screen: Stainless steel with round perforations, unless otherwise indicated

5. Perforation Size

    a. NPS 2-inch and Smaller: 0.020 inch

    b. NPS 2-1/2-inch to NPS 4-inch: 0.045 inch

    c. NPS 5-inch and Larger: 0.10 inch

6. Drain: Factory-installed, hose-end drain valve

## 2.04 HOSE BIBBS

A. Hose Bibbs

1. Standard: ASME A112.18.1 for faucets

2. Body Material: Bronze

3. Seat: Bronze, replaceable

4. Supply Connections: NPS 3/4-inch threaded or solder-joint inlet

5. Outlet Connection: Garden hose thread complying with ASME B1.20.7

6. Pressure Rating: 125 psig

7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011

8. Refer to Plumbing Fixture Schedule on Drawings for finishes.

## 2.05 WALL HYDRANTS

A. Non-Freeze Wall Hydrants

1. Manufacturers

    a. Josam Company

    b. MIFAB, Inc.

    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

    d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Woodford Manufacturing Company

g. Zurn Plumbing Products Group

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants

3. Pressure Rating: 125 psig

4. Operation: Loose key

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp

6. Inlet: NPS 3/4-inch

7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7

8. Box: Deep, flush mounting with cover

9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7

10. Operating Keys(s): One with each wall hydrant

11. Refer to Plumbing Fixture Schedule on Drawings for finishes.

## 2.06 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves

1. Standard: MSS SP-110 for standard-port, two-piece ball valves

2. Pressure Rating: 400-psig minimum CWP

3. Body: Copper alloy

4. Ball: Chrome-plated brass

5. Seats and Seals: Replaceable

6. Handle: Vinyl-covered steel

7. Inlet: Threaded or solder joint

8. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.07 WATER HAMMER ARRESTERS

A. Water Hammer Arresters

1. Manufacturers

a. Josam Company

b. MIFAB, Inc.

c. PPP Inc.

d. Sioux Chief Manufacturing Company, Inc.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group

2. Standard: ASSE 1010 or PDI-WH 201

3. Type: Copper tube with piston

4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F

## 2.08 AIR VENTS

A. Bolted-Construction Automatic Air Vents

1. Body: Bronze

2. Pressure Rating:125-psig minimum pressure rating at 140 deg F

3. Float: Replaceable, corrosion-resistant metal

4. Mechanism and Seat: Stainless steel

5. Inlet and Vent Outlet End Connections: Threaded

B. Welded-Construction Automatic Air Vents

1. Body: Stainless steel

2. Pressure Rating: 150-psig minimum pressure rating

3. Float: Replaceable, corrosion-resistant metal

4. Mechanism and Seat: Stainless steel

5. Inlet and Vent Outlet End Connections: Threaded

## 2.09 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves

1. Manufacturers

a. MIFAB, Inc.

b. PPP Inc.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018

3. Pressure Rating: 125 psig minimum

4. Body: Bronze

5. Inlet and Outlet Connections: NPS 1/2-inch threaded, union, or solder joint

6. Gravity Drain Outlet Connection: NPS 1/2-inch threaded or solder joint

7. Distribution box as required

8. Finish: Chrome plated or rough bronze for units used with pipe or tube that is not chrome finished

## 2.10 STAINLESS STEEL HOSE REEL

A. Manual crank rewind with cam-lock brake and spring actuated pin lock

B. 90-degree inlet with stainless steel ball bearing swivel joint and 1-inch female NPT threads

C. Heavy-duty stainless steel angle mounting bracket for column or wall mounting

D. Storage for up to 75 feet of 1-inch or 3/4-inch I.D. hose

E. Swiveling hose connection point

F. Pressure rated for up to 2,000 psi, temperature rated to 250 F.

G. Unit shall be Hosecraft, Steel Eagle, Hannay Reels, Inc., or approved equal.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Refer to Section 22 05 00 – Basic Plumbing Requirements for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

2. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

E. Install water hammer arresters in water piping according to PDI-WH 201 and Drawings.

F. Install air vents at high points of water piping. Install drain piping and discharge to floor drain.

G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

### 3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Connect wiring according to Section 26 05 19 – Low-Voltage Conductors and Cables.

## 3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers

2. Intermediate atmospheric-vent backflow preventers

3. Reduced-pressure-principle backflow preventers

4. Double-check backflow-prevention assemblies

5. Automatic balancing valves

6. Outlet boxes

7. Supply-type, trap-seal primer valves

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 – Identification for Plumbing Piping and Equipment.

## 3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and vacuum breaker assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

**END OF SECTION**

# SECTION 22 13 16
# SANITARY WASTE AND VENT PIPING

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. This Section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 00 – Basic Plumbing Requirements.

### 1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 75 00 – Checkout and Startup Procedures

C. Section 07 84 00 – Firestopping for penetrations in rated enclosures

D. Section 07 90 00 – Joint Fillers, Sealants and Caulking for sealant products

E. Section 09 90 00 – Painting for preparation and finish painting and identification of piping systems

F. Section 22 05 00 – Common Results for Plumbing for pipe hangers and supports, materials identification

G. Section 22 07 19 – Plumbing Piping Insulation

H. Section 22 08 00 – Commissioning of Plumbing

I. Section 26 05 26 – Grounding and Bonding for Electrical Systems

J. Section 26 05 33.13 – Conduit for Electrical Systems

K. Section 26 05 33.16 – Boxes for Electrical Systems

### 1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

032819

B. ASME

1. A13.1-2007 – Scheme for the Identification of Piping Systems

2. A112.36.2M-1991(R 2012) – Cleanouts

3. A112.6.3-2001 (R2007) – Standard for Floor and Trench Drains

4. B1.20.1-2013 – Pipe Threads, General Purpose (Inch)

5. B16.1-2010 – Gray Iron Pipe Flanges and Flanged Fittings

6. B16.4-2011 – Standard for Grey Iron Threaded Fittings Classes 125 and 250

7. B16.15-2013 – Cast Copper Alloy Threaded Fittings, Classes 125 and 250

8. B16.18-2012 – Cast Copper Alloy Solder Joint Pressure Fittings

9. B16.21-2011 – Nonmetallic Flat Gaskets for Pipe Flanges

10. B16.22-2013 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

11. B16.23-2011 – Cast Copper Alloy Solder Joint Drainage Fittings: DWV

12. B16.24-2001 (R2006) – Cast Copper Alloy Pipe Flanges and Flanged Fittings

13. B16.29-2012 – Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV

14. B16.39-2009 – Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

15. B18.2.1-2012 – Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

C. ASSE

1. 1001-2008 – Performance Requirements for Atmospheric Type Vacuum Breakers

2. 1018-2001 – Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied

3. 1044-2001 – Performance Requirements for Trap Seal Primer Devices – Drainage Types and Electronic Design Types

4. 1079-2012 – Performance Requirements for Dielectric Pipe Unions

D. ASTM

1. A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated, Welded and Seamless

2. A74 – Standard Specification for Cast Iron Soil Pipe and Fittings

3. A888 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

4. B32 – Standard Specification for Solder Metal

5. B43 – Standard Specification for Seamless Red Brass Pipe, Standard Sizes

6. B75 – Standard Specification for Seamless Copper Tube

7. B88 – Standard Specification for Seamless Copper Water Tube

8. B306 – Standard Specification for Copper Drainage Tube (DWV)

9. B584 – Standard Specification for Copper Alloy Sand Castings for General Applications

10. B687 – Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

11. B813 – Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

12. B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings

13. C564 – Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

14. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

15. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

16. D2564 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

17. D2665 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

18. D2855 – Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

19. D5926 – Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems

20. F402 – Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

21. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

22. F1545 – Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges

E. CISPI

1. 2006 – Cast Iron Soil Pipe and Fittings Handbook

2. 301-2012 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

3. 310-2012 – Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

F. CDA

1. A4015 – Copper Tube Handbook

G. ICC

1. IPC – International Plumbing Code

H. MSS

1. SP-123-2013 – Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube

I. NFPA

1. 70 – National Electrical Code (NEC)

J. PDI

1. WH-201 (R 2010) – Water Hammer Arrestors Standard

K. UL

1. 508-99 (R2013) – Standard for Industrial Control Equipment

## 1.04 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Piping
2. Floor Drains
3. Cleanouts
4. Trap Seal Protection
5. Penetration Sleeves
6. Pipe Fittings
7. Traps
8. Exposed Piping and Fittings

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

## 1.05 AS-BUILT DOCUMENTATION

A. The installing subcontractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in AutoCAD file format provided on DVD or flash drive. Should the installing subcontractor or Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the ‘third party testing company’ requirement.

B. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this Project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

## PART 2 – PRODUCTS

### 2.01 SANITARY WASTE, DRAIN, AND VENT PIPING

A. Cast Iron Waste, Drain, and Vent Pipe and Fittings

1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:

    a. Pipe buried in or in contact with earth.

    b. Sanitary pipe extensions to a distance of approximately 5 feet outside of the building.

    c. Interior waste and vent piping above grade.

2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).

3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.

4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.

5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.

B. Polyvinyl Chloride (PVC) Pipe and Fittings

1. PVC pipe and fittings are permitted where the waste temperature is below 140 degrees F.

2. PVC piping and fittings shall NOT be used for the following applications:

    a. Waste collected from dryer condensate or waste drains.

    b. Vertical waste and soil stacks subject to vehicle traffic.

    c. Exposed in mechanical equipment rooms.

3. PVC sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.

4. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

## 2.02 EXPOSED WASTE PIPING

A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Owner or specified in other sections.

1. The pipe shall meet ASTM B43, regular weight.

2. The fittings shall conform to ASME B16.15.

3. Nipples shall conform to ASTM B687, Chromium-plated.

4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. In unfinished rooms such as mechanical rooms and kitchens, chrome-plated brass piping is not required. The pipe materials specified under Article 2.01 WASTE, DRAIN, AND VENT PIPING shall be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 90 00 – Painting.

## 2.03 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.

2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.

3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 125 psig at a minimum temperature of 180 degrees F. The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 150 psig. The gasket shall be neoprene or

phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The dielectric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 300 psig at 225 degrees F. The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

## 2.04 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 4 inches; and not less than 4 inches for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 24 inches shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 2 inches. When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two-way cleanouts shall be provided where indicated on Drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 6 by 6 inches shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

## 2.05 FLOOR DRAINS

A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed

in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 16-ounce soft copper flashing membrane, 24 inches square or another approved waterproof membrane shall be provided.

## 2.06 TRAPS

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

## 2.07 TRAP SEAL PROTECTION

A. Trap Primer: The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 125 psig and conforming to standard ASSE 1018.

1. The inlet and outlet connections shall be NPS 1/2 inch.

2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.

3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.

4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.

5. The manifold shall be omitted when serving only one trap.

## 2.08 PENETRATION SLEEVES

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 2 inches above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

## PART 3 – EXECUTION

### 3.01 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Owner or specified in other Sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings where possible.

F. The piping shall be installed to permit valve servicing or operation.

G. The piping shall be installed free of sags and bends.

H. Seismic restraint shall be installed where required by code.

I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.

K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"

L. Aboveground copper tubing shall be installed according to CDA Copper Tube Handbook.

M. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

N. If an installation is unsatisfactory to the Engineer, the Contractor shall correct the installation at no cost to the Owner.

## 3.02 JOINT CONSTRUCTION

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's Cast Iron Soil Pipe and Fittings Handbook for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's Cast Iron Soil Pipe and Fittings Handbook for lead and oakum calked joints.

C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's Cast Iron Soil Pipe and Fittings Handbook for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.

2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead-free alloy solder conforming to ASTM B32 shall be used.

F. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

## 3.03 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

## 3.04 PIPE HANGERS, SUPPORTS AND ACCESSORIES

A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 00 – Basic Plumbing requirements, and these specifications. Where conflicts arise between these the code and Section 22 05 00 – Basic Plumbing

Requirements the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 90 00 – Painting. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

C. Horizontal piping and tubing shall be supported within 12 inches of each fitting or coupling.

D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. NPS 1-1/2-Inch to NPS 2-inch: 60 inches with 3/8-inch rod

2. NPS 3-inch: 60 inches with 1/2-inch rod

3. NPS 4-inch to NPS 5-inch: 60 inches with 5/8-inch rod

4. NPS 6-inch to NPS 8-inch: 60 inches with 3/4-inch rod

5. NPS 10-inch to NPS 12-inch: 60 inches with 7/8-inch rod

E. The maximum spacing for plastic pipe shall be 4 feet.

F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 15 feet.

G. In addition to the requirements in Section 22 05 00 – Basic Plumbing Requirements shall have the following characteristics:

1. Solid or split unplated cast iron.

2. All plates shall be provided with set screws.

3. Height adjustable clevis type pipe hangers.

4. Adjustable floor rests and base flanges shall be steel.

5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.

6. Riser clamps shall be malleable iron or steel.

7. Rollers shall be cast iron.

8. See Section 22 05 00 – Basic Plumbing Requirements, for requirements on insulated pipe protective shields at hanger supports.

H. Miscellaneous materials shall be provided as specified, required, directed or as noted on the Drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 20 feet for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

J. Penetrations

1. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00 – Firestopping. Clearances between raceways and openings shall be completely filled and sealed with the firestopping materials.

2. Waterproofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 90 00 – Joint Fillers, Sealants and Caulking.

K. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

**3.05 TESTS**

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 10-foot head of water. In testing successive sections, test at least upper 10 feet of next preceding section so that each joint or pipe except upper most 10 feet of system has been submitted to a test of at least a 10-foot head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.

2. For an air test, an air pressure of 5 psig gauge shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gauge shall be used for the air test.

3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.

4. Final Tests: Either one of the following tests may be used.

    a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1 inch of water with a smoke machine. Chemical smoke is prohibited.

    b. Peppermint Test: Introduce 2 ounces of peppermint into each line or stack.

**END OF SECTION**

## SECTION 22 13 19
## SANITARY WASTE PIPING SPECIALTIES

### PART 1 – GENERAL

### 1.01 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts
2. Floor drains
3. Roof flashing assemblies
4. Through-penetration firestop assemblies
5. Miscellaneous sanitary drainage piping specialties
6. Flashing materials

B. Related Sections include the following:

1. Section 22 05 00 – Basic Plumbing Requirements for piping joining materials, joint construction, and basic installation requirements

### 1.02 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

B. Field quality-control test reports

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

### 1.03 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use

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C. Comply with NSF/ANSI 14 – Plastics Piping System Components and Related Materials for plastic sanitary piping specialty components.

## 1.04 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 - Concrete.

B. Coordinate size and location of roof penetrations.

# PART 2 – PRODUCTS

## 2.01 CLEANOUTS

A. Cleanouts

1. Basis-of-Design Product: Subject to compliance with requirements, refer to the following for area and provide the product indicated or a comparable product by one of the following:

    a. Exterior: J. R. Smith 4240 – round with cast iron cover

    b. Wall: J.R. Smith Series 4710

    c. Concrete Floors: J. R. Smith Series 4100 with round galvanized cast iron top

    d. Truck/Loading Dock Areas: J. R. Smith Series 4231 with ductile iron top

    e. Acceptable Manufacturers

        1) Josam Company; Josam Div.

        2) MIFAB, Inc.

        3) Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

        4) Tyler Pipe; Wade Div.

        5) Watts Drainage Products Inc.

        6) Zurn Plumbing Products Group; Specification Drainage Operation

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee

3. Body Material: Cast-iron as required to match connected piping

4. Closure: Countersunk or raised-head, brass plug

5. Closure Plug Size: Same as or not more than one size smaller than cleanout size

## 2.02 FLOOR DRAINS AND FLOOR SINKS

A. Floor Drains and Floor Sinks

1. Manufacturers

a. Josam Company; Josam Div.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Light Commercial Operation

2. Standard: ASME A112.6.3

3. Refer to schedule on Drawings.

## 2.03 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company; Elmdor/Stoneman Div.

b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq ft, 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized steel boot reinforcement and counterflashing fitting

## 2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Hub Drain

1. Description: Shop or field fabricate from ASTM A74, service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section, and where required, increaser fitting joined with ASTM C564 rubber gaskets.

2. Size: As indicated on Drawings

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression

b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope

c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression

3. Install floor drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Assemble open drain fittings and install with top of hub 1 inch above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor drain, trap seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet

J. Install air-gap fittings on draining-type backflow preventers and on indirect waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

N. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

## 3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections of Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

## 3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings according to Section 07 60 00 – Flashing and Sheet Metal.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

## 3.04 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION**

# SECTION 22 15 00
# GENERAL SERVICE COMPRESSED AIR

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Materials and installation for piping, fittings, equipment used in compressed air systems

### 1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 73 23 – Seismic Anchorage and Bracing

C. Section 01 75 00 – Checkout and Startup Procedures

D. Section 22 05 00 – Common Results for Plumbing

### 1.03 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASME

1. ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels

a. BPVC-VIII B BPVC Section VIII – Rules for Construction of Pressure Vessels Division 1

b. BPVC-VIII-2 B, BPVC Section VIII – Rules for Construction of Pressure Vessels Division 2 - Alternative Rules

c. BPVC-VIII-3 B, BPVC Section VIII – Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels

2. ASME B16.5 – Pipe Flanges and Flanged Fittings

3. ASME B16.11 – Forged Fittings, Socket-Welding and Threaded

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C. ASTM

1. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

2. ASTM A181/A181M – Standard Specification for Carbon Steel Forgings for General Purpose Piping

D. SSPC

1. SSPC SP-10 – Near White Metal Blast Cleaning

## 1.04 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data

1. Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

2. Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

C. Shop Drawings

1. Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system.

a. Vertical and horizontal piping locations and elevations and connections details.

b. Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

c. Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

d. Instructions: submit manufacturer's installation instructions.

e. Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 77 19 – Closeout Requirements.

## 1.05 QUALITY ASSURANCE

A. Pre-Installation Meeting

1. Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.

a. Verify project requirements.

b. Review installation conditions.

c. Coordination with other building subtrades.

d. Review manufacturer's installation instructions and warranty requirements.

## 1.06 DELIVERY, STORAGE AND HANDLING

A. Waste Management and Disposal

1. Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

2. Remove from site and dispose of packaging materials at appropriate recycling facilities.

3. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

4. Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with WMP.

5. Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

6. Divert unused metal materials from landfill to metal recycling facility as approved by Owner.

## 1.07 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on DVD or flash drive inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written

description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing subcontractor shall maintain as-built drawings of each completed phase for verification and shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in AutoCAD file format provided on DVD or flash drive. Should the installing subcontractor or Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to Engineer 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

## PART 2 – PRODUCTS

### 2.01 COMBINATION FILTER-REGULATOR

A. Factory assembled, heavy-duty with mounting bracket and low-pressure side relief valve.

B. Maximum Inlet Pressure: 150 psi

C. Operating Temperature: 0 to 125 degrees F

D. Filter Element: 5-micron

E. Bowls: Polycarbonate

F. Pressure Range in Regulator: 5 to 130 psi

G. Gauge Range: 0 to 215 psi

## 2.02 PIPING

A. Above Grade Interior Piping: ASTM A53/A53M, Type E or S, Grade B, Schedule 80 seamless black steel rated for 175 psi.

1. Fittings

a. NPS 2-Inch and Smaller: To ASME B16.11, Schedule 80 steel, socket welded or threaded

b. NPS 2-1/2-Inch and Larger: To ASME B16.11, Schedule 80 steel, butt or socket welded

2. Couplings: To ASME B16.11, socket welded or threaded half coupling type rated for 175 psi

3. Unions: 150-psi malleable iron with brass-to-iron ground seat, rated for 175 psi

4. Dissimilar Metal Junctions: Use dielectric unions.

5. Flanges

a. NPS 2-Inch and Smaller: To ASME B16.5, forged steel, raised face and socket welded

b. NPS 2-1/2-Inch and Larger: to ASME B16.5, forged steel, raised face and slip-on or weld neck

6. Joints

a. NPS 2-Inch and Smaller: Threaded or socket welded

b. NPS 2-1/2-Inch and Larger: Butt welded

## 2.03 OUTLETS

A. For threaded outlets 3 inches and smaller, use threadolet type. Outlets shall be 3,000-pound WOG forged steel per ASTM A105 or ASTM A216, Grade WCB. Threads shall comply with ASME B1.20.1, NPT. Outlets shall be Bonney Forge Co. “Threadolet”, Allied Piping Products Co. “Brancholet” or equal.

## 2.04 BALL VALVES

A. Three-piece design or top entry for ease of in-line maintenance.

1. To ASTM A181/A181M, Class 70, carbon steel body socket welded or screwed ends, carbon steel ball and associated trim suitable for compressed air application.

2. To withstand 150 psi maximum pressure.

## 2.05 COUPLERS/CONNECTORS

A. Industrial interchange series, full-bore

B. Maximum Inlet Pressure: 250 psi

C. Valve Seat: Molded nylon

D. Body: Zinc plated steel

E. Threads: NPT

# PART 3 – EXECUTION

## 3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

## 3.02 MAIN AIR PRESSURE REGULATORS

A. Install at air compressor station.

B. Install additional regulators on connections to equipment as indicated.

## 3.03 FABRICATION, ASSEMBLY, AND ERECTION

A. Beveled ends for butt welding shall conform to ASME B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.

B. Fabrication shall comply with ASME B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.

C. Apply full penetration weld to exterior joint of butt welded pipe, fittings, and welding neck flanges. Apply fillet welds to the interior and exterior circumference of the pipe and slip on flanges. Minimum size of fillet weld shall be equal to the steel cylinder thickness. Complete each pass around the entire circumference of the pipe before commencing the next pass. Use electrodes recommended by the pipe fabricator. Do not deposit more

than 1/8-inch of throat thickness per pass. The minimum number of passes or beads in the completed weld shall be as follows:

| Steel Cylinder Thickness (inches) | Minimum Number of Passes for Welded Joints |
|---|---|
| 0.25 and Smaller | Two |
| Greater than 0.25 | Three |

D. Use the shielded metal arc welding (SMAW) process for welding.

E. Welding preparation shall comply with ASME B31.3, Paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ASME B31.3, Table 341.3.2, and Paragraph 341.4 for visual examination.

F. Identify welds in accordance with ASME B31.3, Paragraph 328.5.

G. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

H. Welding electrodes shall comply with AWS A5.1.

I. After shop fabrication and prior to shop applied epoxy, test each welded joint by the liquid penetrant method. Conform to the requirements specified in ASTM E165. The materials used shall be either water washable or nonflammable. Products: "Spotcheck" by the Magnaflux Corporation or "Met-L-Check Flaw-Findr" by the Met-L-Check Company. Chip out all defects, reweld, and retest the section affected until it shows no leaks or other defects.

## 3.04 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

A. Install flexible connection.

B. Install shut-off valves at outlets, major branch lines and in locations as indicated.

C. Install quick-coupler chucks and pressure gauges on drop pipes.

D. Install unions to permit removal or replacement of equipment.

E. Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.

F. Grade piping at 1% slope minimum.

G. Install compressed air trap and pressure equalizing pipe at moisture collecting points. Route drain pipe to nearest floor drain.

H. Make branch connections from top of main or quick branch drop pipe if using aluminum piping system.

I. Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 100 feet (30 m) maximum.

J. Provide drain from refrigerated air dryer.

K. Weld steel piping in accordance with ASME code and requirements of authority having jurisdiction.

1. Weld concealed and inaccessible piping regardless of size.

## 3.05 FIELD QUALITY CONTROL

A. Site Tests/Inspection

1. Testing: Pressure test in accordance with requirements of ASME B31.3, for 4 hours minimum, to 150 psi or 1.5 times the working pressure whichever is higher, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 1.5 psi or 10% of the test pressure.

B. Manufacturer's Field Services

1. Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

2. Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

3. Schedule site visits to review work at stages listed:

a. After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

b. Twice during progress of work at 25% and 60% complete.

c. Upon completion of Work, after cleaning is carried out.

C. Obtain reports within 3 working days of review and submit immediately to Owner.

## 3.06 CLEANING

A. Refer to Section 22 05 00 – Common Results for Plumbing.

B. Cleaning: Blow out piping to clean interior thoroughly of oil and foreign matter.

C. Check entire installation is approved by authority having jurisdiction.

D. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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# SECTION 22 33 00
# ELECTRIC DOMESTIC WATER HEATERS

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. This Section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 00 – Common Results for Plumbing.

### 1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

C. Section 01 75 00 – Checkout and Startup Procedures

D. Section 03 30 00 – Cast-In-Place Concrete for concrete and grout

E. Section 09 90 00 – Painting for preparation and finish painting

F. Section 22 05 00 – Basic Plumbing Requirements

G. Section 22 05 19 – Meters and Gauges for Plumbing Piping

H. Section 22 07 19 – Plumbing Piping Insulation

I. Section 22 08 00 – Commissioning of Plumbing System

J. Section 22 11 13 – Facility Water Distribution Piping for piping, fittings, valves and gauges

### 1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ANSI

1. Z21.22B – Relief Valves for Hot Water Supply Systems

03/29/22

C. ASHRAE

1. 90.1 (2013) – Energy Standard for Buildings Except Low-Rise Residential Buildings

D. ASME

1. ASME Boiler and Pressure Vessel Code

2. BPVC Section IV-2013 – Rules for Construction of Heating Boilers

3. BPVC Section VIII-1-2013 – Rules for Construction of Pressure Vessels, Division 1

4. Form U-1 – Manufacturer's Data Report for Pressure Vessels

5. B1.20.1 – Pipe Threads, General Purpose (Inch)

6. B16.5 – Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

7. B16.24 – Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

8. CSD-1-2012 – Controls and Safety Devices for Automatically Fired Boilers

E. ASSE

1. 1005-1999 – Performance Requirements for Water Heater Drain Valves, 3/4 Inch Size

F. NFPA

1. 70 – National Electrical Code (NEC)

G. NSF

1. 5-2012 – Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment

2. 61-2012 – Drinking Water System Components – Health Effects

3. 372-2011 – Drinking Water System Components – Lead Content

H. UL

1. 174-04 (R2012) – Standard for Household Electric Storage Tank Water Heaters

2. 499-05 (R2013) – Standard for Electric Heating Appliances

3. 1453-04 (R2011) – Standard for Electric Booster and Commercial Storage Tank Water Heaters

## 1.04 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Manufacturer's Literature and Data: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Water Heaters

2. Pressure and Temperature Relief Valves

3. Thermometers

4. Pressure Gauges

5. Vacuum Breakers

6. Expansion Tanks

C. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:

1. Rated capacities

2. Operating characteristics

3. Electrical characteristics

4. Furnished specialties and accessories

5. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code

D. Shop drawings shall include wiring diagrams for power, signal and control functions.

E. Seismic qualification certificates shall be submitted that details equipment anchorage components, identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.

F. Submit documentation indicating compliance with applicable requirements with ASHRAE 90.1 for Service Water Heating.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00 – Commissioning of Plumbing.

## 1.05 QUALITY ASSURANCE

A. For efficiency performance in commercial applications, comply with ASHRAE 90.1 – Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings for commercial water heaters.

B. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for intended location and application.

C. ASME code construction shall be a vessel fabricated in compliance with the ASME BPVC Section VIII-1.

D. Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

E. The electric domestic water heater shall conform to Section 01 73 23 – Anchorage and Bracing of Nonstructural Components, withstanding seismic movement without separation of any parts from the equipment when subjected to a seismic event.

F. The domestic water heater shall be certified and labeled by an independent testing agency.

## 1.06 AS-BUILT DOCUMENTATION

A. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare

parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in AutoCAD file format provided on DVD or flash drive. Should the installing subcontractor or Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

## PART 2 – PRODUCTS

### 2.01 ELECTRIC DOMESTIC WATER HEATERS

A. The tank construction shall be steel shell, with an inner tank liner complying with NSF 61 and NSF 372 for barrier materials for potable water. The inner liner shall be extended into the openings. The vessel shall be ASME BPVC Section VIII-1, fabricated with a pressure rating of 150 psig. Provide with access for cleaning and disinfection.

B. Tapping (openings) shall be Factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards B1.20.1 for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls as required. Tappings shall comply with the following ASME standards listed below:

1. 2-Inch and Smaller: Threaded ends according to ASME B1.20.1.

2. 2-1/2-Inch and Larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B16.24.

C. Tank insulation shall comply with ASHRAE 90.1 requirements.

D. For domestic water heater sizes greater than 9 KW, the heating element shall be arranged in multiples of three elements. For heaters less than 9 KW, the heater elements shall be arranged in double elements. Heater capacities are scheduled on the Drawings.

E. The domestic water heaters shall have screw in or bolt on immersion type, thermostatically adjustable elements. Set thermostat for minimum water storage temperature of 140 degrees F. The electrical characteristics are scheduled on the Drawings. Heaters shall be capable of raising the discharge temperature to 170 to 180 degrees F for thermal eradication.

F. The combination pressure and temperature relief Valve shall be ANSI Z21.22 and ASME rated.

G. The anode rod shall be replaceable magnesium.

H. The drain valve shall be corrosion-resistant metal complying with ASSE 1005.

I. Comply with NSF 5 for water heaters.

## 2.02 DOMESTIC HOT WATER EXPANSION TANKS

A. A steel pressure-rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air precharge shall be set to minimum system operating pressure at tank.

B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.

C. The interior finish shall comply with NSF 61 and NSF 372 for barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.

D. The air charging valve shall be factory installed.

## 2.03 ELECTRIC WATER HEATER DRAIN PAN

A. A stainless steel drain pan shall be provided that is large enough to contain the volume of the heater. The drain pan shall include a drain outlet not less than NPS 3/4 inch with ASME B1.20.7 garden hose threads.

## 2.04 HEAT TRAPS

A. Heat traps shall be installed in accordance with ASHRAE 90.1 unless provided integrally with the heater.

## 2.05 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

A. The combination pressure and temperature relief valve shall be ANSI Z21.22 and ASME rated and constructed of all brass or bronze with a self-closing reseating valve. The relief valves shall include a relieving capacity greater than the heat input and include a pressure setting less than the water heater’s working pressure rating. Sensing element shall extend into storage tank.

## 2.06 THERMOMETERS

A. Thermometers shall be rigid stem or remote sensing, scale or dial type with an aluminum, black metal, stainless steel, or chromium plated brass case. The thermometer shall be back connected, red liquid (alcohol or organic-based) fill, vapor, bi-metal or gas actuated, with 9 inches high scale dial or circular dial 2 to 5 inches in diameter graduated from 40 to 212 degrees F, with two-degree graduations guaranteed accurate within one scale division. The socket shall be separable, double-seat, micrometer-fittings, with

extension neck not less than 2-1/2 inches to clear tank or pipe covering. The thermometer shall be suitable for 3/4 inch pipe threads. Thermometers may be console-mounted with sensor installed in separate thermometer well.

## 2.07 SUPPORTS

A. Water heater stands shall be factory-fabricated steel for floor mounting capable of supporting water heater and water a minimum of 18 inches above the floor.

B. Wall brackets for wall mounted heaters shall be factory-fabricated steel capable of supporting water heater and water.

## 2.08 MANIFOLD KITS

A. For multiple water heater installation, provide factory-fabricated copper manifold kits to include ball-type shutoff valves to isolate each water heater and balancing valves to provide balanced flow through each water heater.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Water heaters shall be installed on concrete bases unless elevated above the floor. Refer to Specification Section 03 30 00 – Cast-In-Place Concrete and Section 22 05 00 – Common Results for Plumbing.

B. The water heaters shall be installed level and plumb and securely anchored.

C. The water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.

D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains with air gap or break.

E. Thermometers shall be installed on the water heater inlet and outlet piping and shall be positioned such that they can be read by an operator or staff standing on floor or walkway.

F. The thermostatic control shall be set for a minimum setting of 140 degrees F for storage heaters and regulated to a maximum discharge temperature of 130 degrees F for distribution to personnel.

G. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.

H. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed. Refer to Section 22 11 13 – Facility Water Distribution Piping.

I. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.

J. All manufacturer's required clearances shall be maintained.

K. The electric domestic water heaters shall be installed with seismic restraint devices.

L. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank in accordance with manufacturer's recommendations. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.

M. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic water heater storage tanks if not provided integrally with the tanks.

N. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic water heaters without integral drains.

O. If an installation is unsatisfactory to the Engineer, the Contractor shall correct the installation at no cost to the Owner.

## 3.02 LEAKAGE TEST

A. Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 200 psig and 240 psig for a unit with a MAWP of 160 psig. Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the Owner.

## 3.03 PERFORMANCE TEST

A. All of the remote water outlets shall have a minimum of 110 degrees F and a maximum of 120 degrees F water flow at all times.

## 3.04 STARTUP AND TESTING

A. As recommended by product manufacturer and listed standards and under actual or simulated operating conditions, tests shall be conducted to prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system.

B. The tests shall include system capacity, control function, and alarm functions.

C. When any defects are detected, correct defects and repeat test at no additional costs to the Owner.

D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting

Officer's Representative and Commissioning Agent. Provide a minimum of 7 days prior to notice.

## 3.05 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00 – Commissioning of Plumbing.

B. Components provided under this Section will be tested as part of a larger system.

**END OF SECTION**

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## SECTION 23 00 00
## BASIC HVAC REQUIREMENTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment and material for the complete installation of the heating, ventilation, air conditioning, piping, etc. as indicated on the Drawings and specified herein.

B. Air conditioning systems shall be furnished and installed to operate as a system. The Contractor shall coordinate all requirements between manufacturers to insure unit responsibility and compatibility of the systems.

### 1.02 SUBMITTALS

A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Data to be submitted shall include but not be limited to:

1. Catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.

2. Complete assembly, and installation drawings with clearly marked dimensions. This information shall be in sufficient detail to serve as a guide for assembly and disassembly and for ordering parts.

3. Weight of all component parts and assembled weight.

4. Electrical characteristics, wiring, diagrams, etc.

5. Sample data sheet of equipment nameplate(s) including information contained thereon.

6. Insulation materials, coating, jackets, detail density, thermal conductivity and thickness of all insulation materials to be furnished.

7. Details of special fasteners and accessories.

8. Type of adhesives, binders, joint cement, mastics.

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9. Proposed insulation procedures and installation methods.

10. Spare parts list

11. Special tools list

C. The Contractor shall obtain from the manufacturer and submit to the Engineer copies of the results of all certified shop tests.

D. The Contractor shall obtain from the manufacturer and submit to the Engineer copies of certified letters of compliance in accordance with the Specifications.

## 1.03 RELATED WORK

A. Division 01 – General Requirements

B. Section 01 33 00 – Submittal Procedures

C. Section 01 73 23 – Anchorage and Bracing of Non-Structural Components

D. Section 01 74 00 – Cleaning and Waste Management

E. Section 01 75 00 – Checkout and Startup Procedures

F. Section 03 30 00 – Cast-In-Place Concrete

G. Section 05 50 00 – Metal Fabrications

H. Section 07 84 00 – Firestopping

I. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

J. Section 09 90 00 – Painting

K. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC)

L. Section 26 05 00 – Basic Electrical Requirements

M. Section 26 05 19 – Low-Voltage Conductors and Cables

N. Section 26 29 26 – Low-Voltage Variable Frequency Motor Controllers

## 1.04 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance (O&M) manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01 – General Requirements.

B. O&M Manuals shall be submitted for all equipment.

## 1.05 MANUFACTURER'S INSTRUCTIONS

A. Installation of all equipment shall be in accordance with manufacturer's data.

B. All changes from the installation procedures in manufacturers' data shall be submitted for approval in accordance with the requirements for shop drawings.

C. Keep all manufacturers' data provided in a secure manner at the job site at all times. Catalog and index this data for convenient reference.

D. Manufacturers' data shall be available for the information of the Owner, Engineer, and the use of other trades.

E. Turn over all data to the Owner through the Engineer at completion of the Work and final testing.

F. Furnish Owner, indexed and bound in loose leaf binders, three complete sets of Operating and Maintenance Instructions and pertinent manufacturers' literature and information on all of the apparatus and equipment under this Division of the Specifications.

G. Submit all instruction books and manuals in accordance with Division 01 – General Requirements.

## 1.06 CODES, PERMITS AND STANDARDS

A. The Contractor shall obtain and pay for all permits and shall comply with all laws and codes that apply to the HVAC work.

B. The Contractor shall be responsible for all added expense due to their choice of equipment, materials or construction methods.

C. All work and materials shall be in full accordance with the latest state rules and regulations or publications including those of the state of Georgia and/or Cherokee County Fire Marshall, the Uniform Plumbing Code, and all local codes. Nothing in the Drawings and/or Specifications shall be construed to permit work not conforming to the above codes, rules and regulations.

D. All equipment, materials and installations shall conform to the requirements of the most recent edition with latest revisions, supplements and amendments of the following, as applicable:

1. Air Conditioning and Refrigeration Institute (ARI)

2. Air Diffusion Council (ADC)

3. Air Moving and Conditioning Association (AMCA)

4. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)

5. American National Standards Institute (ANSI)

6. American Society for Testing and Materials (ASTM)

7. American Society of Mechanical Engineers (ASME)

8. American Welding Society (AWS)

9. Factory Mutual (FM)

10. National Electric Code (NEC)

11. NFPA 90A - Air Conditioning and Ventilation Systems

12. Occupational Safety and Health Standards (OSHA)

13. Sheet Metal & Air Conditioning Contractors National Association (SMACNA)

14. Standard Building Code

15. Standard Mechanical Code

16. Standard Plumbing Code

17. State and local codes, ordinances and statutes

18. Underwriters Laboratories (UL)

19. Others as designated in the Specifications

## 1.07 QUALITY ASSURANCE

A. All material and equipment shall be the latest design, new, undeteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.

B. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.

C. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.

D. Touch up and/or repaint to match original finishes all factory finished or painted equipment and materials which are scratched or marred during shipment or installation.

E. Products Criteria

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer workstation, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 3 years. See other Specification Sections for any exceptions and/or additional requirements.

2. Refer to all other Sections for quality assurance requirements for systems and equipment specified therein.

3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

4. The products and execution of work specified in Division 23 – Heating, Ventilating, and Air Conditioning (HVAC) shall conform to the referenced codes and standards as required by the Specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the Engineer.

5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required, they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).

6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.

7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

8. Use of asbestos products or equipment or materials containing asbestos is prohibited.

F. HVAC Mechanical Systems Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME BPVC Section IX. Provide proof of current certification.

2. Comply with provisions of ASME B31 – Code for Pressure Piping.

3. Certify that each welder and welding operator has passed AWS qualification tests for the welding processes involved, and that certification is current.

4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the associated code.

G. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer with submittals. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material and removal by the Contractor and no additional cost or time to the Owner.

H. Execution (Installation, Construction) Quality

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the Contract Documents to the Engineer for resolution. Provide written hard copies and computer files on DVD or flash drive of manufacturer’s installation instructions to the Engineer with submittals prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received and approved by the Engineer. Failure to furnish these recommendations is a cause for rejection of the material.

2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to, all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and Contract Documents to the Engineer for resolution. Failure of the Contractor to resolve or point out any issues will result in the Contractor correcting at no additional cost or time to the Owner.

3. Complete coordination shop drawings shall be required in accordance with Article 1.02 SUBMITTALS herein. Construction work shall not start on any system until the coordination shop drawings have been approved by the Engineer.

4. Workmanship/craftsmanship shall be of the highest quality and standards. The Owner reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Owner.

I. Upon request by the Engineer, provide lists of previous installations for selected items of equipment. Include contact persons who shall serve as references, with current telephone numbers and email addresses.

## 1.08 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.

2. Large equipment such as boilers, chillers, cooling towers, fans, and air handling units if shipped on open trailer trucks shall be covered with shrink on plastics or waterproof tarpaulins that provide protection from exposure to rain, road salts and other transit hazards. Protection shall be kept in place until equipment is moved into a building or installed as designed.

3. Repair damaged equipment in first class, new operating condition and appearance or replace same as determined and directed by the Engineer. Such repair or replacement shall be at no additional cost or time to the Owner.

4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.

5. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

6. Protect plastic piping and tanks from ultraviolet light (sunlight).

B. Cleanliness of Piping and Equipment Systems

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.

2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.

4. Boilers shall be left clean following final internal inspection by Owner's insurance representative or inspector.

5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

## 1.09 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the Contract Documents and shown in the maintenance manuals. Identification for piping is specified in Section 09 90 00 – Painting.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 90 00 – Painting permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16 inch) high riveted or bolted to the equipment.

D. Control Items: Label all instrumentation, temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists

1. HVAC and Mechanical Rooms: Provide for all valves.

2. Valve Tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

3. Valve Lists: Typed or printed plastic coated card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

F. Ceiling Grid Labels

1. 50-mm- (2-inch-) long by 15-mm- (1/2-inch-) wide by 0.025-mm- (1-mil-) thick UV-resistant metalized polyester label with red border color and black custom lettering

on white background interior. Peel and stick adhesive backing. Label and adhesive manufactured specifically for use in equipment inventory tagging.

2. Custom print labels with above ceiling HVAC equipment numbers.

G. Pipe and Duct Markers

1. Pipeline Markers

a. Color coding, text height, marker sizing, locations, and flow arrows shall be compliant with ANSI/ASME A13.1 unless specified otherwise.

b. Labels shall be secured in place to be readable from floor level.

c. Markers shall include the following information:

1) Service (i.e., Condensate, Hot Water Supply, Hot Water Return, Hot Gas, Liquid)

2) Direction of Flow Arrow

d. Piping shall be provided with snap-around or snap-on markers that are self secured by the marker coil around the pipe/insulation and shall not require an adhesive. The marker inside diameter shall be sized to not compress insulation when installed.

e. Markers shall be rigid vinyl rated for indoor or outdoor use. The marker shall be surface printed with UV rated ink.

f. For pipes with a contents above 120 degrees Fahrenheit or pipes larger than 6 inches, strap on markers shall be provided. Markers shall be secured using nylon zip ties. Zip ties shall not compress the insulation. Markers shall be oriented such that the tag is easily visible from the floor.

g. Acceptable Manufacturers

1) Seton

2) Brimar

3) Brady

2. Duct Markers

a. Material shall be a thermoplastic with UV overlaminate with permanent pressure sensitive acrylic adhesive backing.

b. Markers shall be a minimum of 5 mils thick with UV overlaminate.

c. Markers shall be suitable for indoor or outdoor service.

d. Marker shall have a minimum height of 2-1/4 inches and a length dictated by the required text indicated below.

e. Lettering shall be a minimum of 1-1/2-inch-high letters.

f. Direction of flow arrow shall be a minimum height of 1-1/2 inch and a minimum length of 3 inches.

g. Provide color-coded duct markers conforming to the following color codes:

| Color | Service |
|---|---|
| Yellow/Green | Supply air |
| Blue | Exhaust, outside, return and mixed air |
| Nomenclature | Include the following:<br>Direction of air flow.<br>Duct service (supply, return, exhaust, etc.)<br>Unit Served |

3. Duct and pipe markers shall be provided at the following locations:

a. At all equipment connections

b. At all wall or floor penetrations on both sides of the wall/floor when a duct enters or leaves a space.

c. At all branches, splits, or tees

d. Every 50 linear feet within a space

## 1.10 GASKETS AND CONNECTORS

A. Provide new gaskets wherever gasketed mating equipment items or pipe connections have been dismantled. Gaskets shall be in accordance with manufacturer's recommendations.

B. Replace all assembly bolts, studs, nuts and fasteners of any kind which are bent, flattened, corroded or have their threads, heads or slots damaged.

C. Furnish all bolts, studs, nuts and fasteners for make-up of all connections to equipment and replace any of these items damaged in storage, shipment or moving.

## 1.11 FIRESTOPPING

A. Section 07 84 00 – Firestopping specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 31 13 – Metal Ducts and Duct Accessories for firestop pipe and duct insulation.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. Each item of equipment shall be furnished and installed complete with all supports, mounting frames, duct work, piping, louvers, panels, grilles, electric drive units and controls, mechanical equipment, electrical work, insulation and appurtenances ready for operation.

B. All equipment and appurtenances shall be anchored or connected to supporting members as specified or as indicated on the Drawings.

C. All mechanisms or parts shall be amply proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication and erection. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials and shall be interchangeable. All equipment shall be of the manufacturer's top line, industrial-commercial grade.

D. The Contractor shall ascertain that all chassis, shafts, and openings are correctly located, otherwise they shall cut all new openings required at the Contractor’s expense. Cutting of new openings shall be coordinated with other trades. Proposed new cutting shall be submitted to the Engineer for review and acceptance prior to cutting.

E. The Drawings shall be taken as diagrammatic. The Contractor shall check the Structural Drawings (plans and sections) for detail dimensions and clearances. Sizes of ducts and their locations are indicated, but not every offset, fitting, or structural obstruction is shown.

F. Alignment of ducts may be varied where necessary to account for slight architectural changes or to avoid conflict with the work of other trades without additional expense to the Owner.

G. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided, unless specifically noted otherwise. Equipment shall be supported on spring-type vibration isolators.

## 2.02 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For Sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.

2. For Blocked-Out Floor Openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.

3. For Drilled Penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. Penetrations through beams or ribs are prohibited but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Engineer.

D. Sheet Metal, Plastic, or Moisture-Resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc-Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or Alternate Black Iron Pipe with Asphalt Coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 90 00 – Joint Fillers, Sealants, and Caulking.

## 2.03 DUCT PENETRATIONS

A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 450 mm (18 inches) high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.

B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See Section 07 84 00 – Firestopping.

## 2.04 SPECIAL TOOLS AND LUBRICANTS

A. Furnish, and turn over to the Engineer, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.

D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Engineer.

E. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## 2.05 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035 inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## 2.06 ASBESTOS

A. Materials containing asbestos are prohibited.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. If an installation is unsatisfactory to the Engineer, the Contractor shall correct the installation at no additional cost or time to the Owner.

### 3.02 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination shop drawings shall be submitted for review. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the Contract Documents.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill is prohibited, except as permitted by Engineer where working area space is limited.

2. Locate holes to avoid interference with structural members such as slabs, columns, ribs, beams or reinforcing. Holes shall be laid out in advance and drilling done only after approval by Engineer. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Engineer for approval.

3. Do not penetrate membrane waterproofing.

F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

G. Electrical Interconnection of Instrumentation or Controls: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The Engineer has the final determination on what is accessible and what is not. Comply with NFPA 70.

H. Protection and Cleaning

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Engineer. Damaged or defective items in the opinion of the Engineer, shall be replaced.

2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Use concrete and non-shrink grout, 20 MPa (3,000 psig) minimum, specified in Section 03 30 00 – Cast-In-Place Concrete.

J. Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Install steam piping expansion joints as per manufacturer’s recommendations.

L. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).

M. Inaccessible Equipment

1. Where the Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment

shall be removed and reinstalled or remedial action performed as directed at no additional cost or time to the Owner.

2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to motors, fans, pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The Engineer has final determination on whether an installation meets this requirement or not.

## 3.03 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities shall generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Article 3.02 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

## 3.04 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Owner under specified restrictions of phasing and maintenance of service requirements as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Owner’s operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Engineer will check structure adequacy and advise Contractor of recommended restrictions.

E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Professional Engineer registered in the state of Georgia.

F. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

G. Follow approved rigging plan.

H. Restore building to original condition upon completion of rigging work.

## 3.05 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels designed by a Structural Professional Engineer, secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Engineer.

B. Use of chain pipe supports; wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above are prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-58. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports

1. Up to 6-inch pipe, 30 feet long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.

2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.

2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.

3. Tubing and capillary systems shall be supported in channel troughs.

G. Floor Supports

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and

seismic conditions (if applicable) without excessive displacement or structural failure.

2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50-mm (2-inch) excess on all edges. Chiller foundations shall have horizontal dimensions that exceed chiller base frame dimensions by at least 150 mm (6 inches) on all sides. Structural portions of Contract Documents shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

4. For seismic anchoring, refer to Section 01 73 23 – Anchorage and Bracing of Non-Structural Components.

## 3.06 MECHANICAL DEMOLITION

A. Rigging access, other than indicated on the Contract Documents, shall be provided by the Contractor after approval for structural integrity by the Engineer. Such access shall be provided without additional cost or time to the Owner. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.

B. In an operating facility, maintain the operation, cleanliness and safety. Owner's personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Debris accumulated in the area to the detriment of plant operation is prohibited. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the Owner, and Contractor shall follow all directives of the Engineer with regard to rigging, safety, fire safety, and maintenance of operations.

C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from property per Section 01 74 00 – Cleaning and Waste Management. This includes all concrete pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with Contract Documents where specifically covered.

Structural integrity of the building system shall be maintained. Reference shall also be made to the portions of the Contract Documents for the other disciplines in the Project for additional facilities to be demolished or handled.

D. All indicated valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Owner's property and shall be removed and delivered to Engineer and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these Contract Documents. Such material shall be removed from the property expeditiously and shall not be allowed to accumulate.

## 3.07 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 90 00 – Painting.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.

2. The following material and equipment shall not be painted:

a. Motors, controllers, control switches, and safety switches

b. Control and interlock devices

c. Regulators

d. Pressure reducing valves

e. Control valves and thermostatic elements

f. Lubrication devices and grease fittings

g. Copper, brass, aluminum, stainless steel and bronze surfaces

h. Valve stems and rotating shafts

i. Pressure gauges and thermometers

j. Glass

k. Nameplates

3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.

4. Pumps, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.

5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats. This may include painting exposed metals where hangers were removed or where equipment was moved or removed.

6. Paint shall withstand the following temperatures without peeling or discoloration:

    a. Condensate: 100 degrees F on insulation jacket surface and 250 degrees F on metal pipe surface.

7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

8. Lead based paints are prohibited.

## 3.08 IDENTIFICATION SIGNS

A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory-Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

C. Pipe Identification: Refer to Section 09 90 00 – Painting.

D. Attach ceiling grid label on ceiling grid location directly underneath above-ceiling air terminal, control system component, valve, filter unit, fan etc.

## 3.09 MOTOR AND DRIVES

A. Use synchronous belt drives only on equipment controlled by soft starters or variable frequency drive motor controllers without a bypass contactor. Use V-belt drives on all other applications.

B. Alignment of V-Belt Drives: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

C. Alignment of Synchronous Belt Drives: Set driving and driven shafts parallel and align so that the corresponding pulley flanges are in the same plane.

D. Alignment of Direct-Connect Drives: Securely mount motor in accurate alignment so that shafts are per coupling manufacturer's tolerances when both motor and driven machine are operating at normal temperatures.

## 3.10 LUBRICATION

A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. Field-check all devices for proper lubrication.

B. All devices and equipment shall be equipped with required lubrication fittings or devices. A minimum of 1 quart of oil and 1 pound of grease of manufacturer's recommended grade and type for each different application shall be provided; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Engineer in unopened containers that are properly identified as to application.

C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

D. All lubrication points shall be extended to one side of the equipment.

## 3.11 STARTUP, TEMPORARY OPERATION AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Owner.

C. The Commissioning Agent shall observe startup and Contractor testing of selected equipment. Coordinate the startup and Contractor testing schedules with Engineer and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

D. Startup of equipment shall be performed as described in equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 11 00 – Summary of Work .

## 3.12 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Section 01 45 23 – Testing Services Furnished by Contractor, 01 75 00 – Checkout and Start-up

Procedures, and in individual Division 23 Specification Sections and submit the test reports and records to the Engineer.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time to the Owner.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work. Rescheduling of these tests shall be requested in writing to Engineer for approval.

D. No adjustments may be made during the acceptance inspection. All adjustments shall have been made by this point.

E. Perform tests as required for commissioning provisions in accordance with Section 23 08 00 – Commissioning of HVAC Systems and Section 01 75 00 – Checkout and Startup Procedures.

## 3.13 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – Commissioning of HVAC Systems.

B. Components provided under this Section of the Specifications shall be tested as part of a larger system.

**END OF SECTION**

## SECTION 23 05 48

## VIBRATION AND SEISMIC CONTROLS FOR HVAC

### PART 1 – GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply to this Section.

B. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

C. Section 05 05 23 – Metal Fastening

### 1.02 SUMMARY

A. This Section includes the following:

1. Isolation pads
2. Isolation mounts
3. Restrained elastomeric isolation mounts
4. Freestanding and restrained spring isolators
5. Housed spring mounts
6. Elastomeric hangers
7. Spring hangers
8. Spring hangers with vertical-limit stops
9. Pipe riser resilient supports
10. Resilient pipe guides
11. Seismic snubbers
12. Restraining braces and cables
13. Steel and inertia, vibration isolation equipment bases

12-03-2024

## 1.03 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning and Development for the State of California.

B. ASCE 7: Minimum Design Loads for Buildings and Other Structures

C. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Equipment

## 1.04 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading

1. Site Class as Defined in the IBC: See Drawing 00-S-001.

2. Seismic Design Category: See Drawing 00-S-001.

3. Assigned Building Occupancy/Risk Category as Defined in the IBC: See Drawing 00-S-001.

a. Component Importance Factor (Ip): 1.0. 1.5 = for fire protection and safety systems, systems required to function after an earthquake, systems whose contents are hazardous, and components attached to an Occupancy/Risk Category IV structure and are needed for continued operation of the facility or their failure could impair continued operation of the facility.

b. Component Response Modification Factor ($R_p$): Per the following table*:

c. Component Amplification Factor ($a_p$): Per the following table*:

| Mechanical Component or Element | Component Amplification Factor ($a_p$) | Component Response Modification Factor ($R_p$) |
|---|---|---|
| Air-side HVAC fans, air handling units, AC units, and terminal units with sheet metal cabinets | 2.5 | 6.0 |
| Pumps, compressors and vessels, free standing, not listed in Chap 15. | 2.5 | 2.5 |
| Boilers and Furnaces (Wet-side) | 1.0 | 2.5 |
| Pressure Vessels on skirts and free-standing stacks | 2.5 | 2.5 |
| Piping per ASME B31, welded or brazed joints | 2.5 | 12.0 |
| Piping per ASME B31, threaded, compression coupled or grooved coupling joints | 2.5 | 6.0 |
| Sheet metal Ductwork, including inline components with joints made by welding or brazing | 2.5 | 9.0 |
| Sheet metal Ductwork, including inline components with joints made other than by welding or brazing | 2.5 | 6.0 |

4. *Refer to most recent version of ASCE 7 tables (Chapter 13 or 15) on component seismic coefficients as governing authority on values shown above and components not listed in table above.

5. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Drawing 00-S-001.

6. Design Spectral Response Acceleration at 1-Second Period: See Drawing 00-S-001.

## 1.05 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer licensed in the state of Georgia and responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases. Provide support reactions.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Seismic-Restraint Details

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths,

and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Pre-approval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Qualification Data: For professional engineer and testing agency.

## 1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M for carbon steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6 for stainless steel materials.

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified Professional Engineer. Submittals without the seal of a qualified registered Professional Engineer’s stamp will be rejected without review and returned for resubmission.

# PART 2 – PRODUCTS

## 2.01 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.

2. Amber/Booth Company, Inc.

3. Cooper B-Line

4. Isolation Technology, Inc.

5. Kinetics Noise Control

6. Mason Industries

7. Vibration Eliminator Co., Inc.

8. Vibration Isolation

9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

L. Resilient Pipe Guides: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.02 VIBRATION ISOLATION EQUIPMENT BASES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.
2. Cooper B-Line
3. Isolation Technology, Inc.
4. Kinetics Noise Control
5. Mason Industries
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation
8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1 inch (25 mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base (refer to drawing details for equipment requiring inertia bases): Factory-fabricated, welded, structural steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1 inch (25 mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## 2.03 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation

3. Cooper B-Line, Inc.; a division of Cooper Industries

4. Hilti, Inc.

5. Kinetics Noise Control

6. Loos & Co.; Cableware Division

7. Mason Industries

8. TOLCO Incorporated; a brand of NIBCO INC.

9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having

jurisdiction. If the authorities having jurisdiction do not list an agency, at a minimum use an evaluation service member of ICC-ES or OSHPD.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A603 galvanized or ASTM A492 stainless steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488. Minimum length of 8 times diameter.

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

## 2.04 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

# PART 3 – EXECUTION

## 3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction. If the authorities having jurisdiction do not list an agency, at a minimum use an evaluation service member of ICC-ES or OSHPD.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

## 3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints

1. Install seismic snubbers on mechanical equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction. If the authorities having jurisdiction do not list an agency, at a minimum use an evaluation service member of ICC-ES or OSHPD, providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 30 feet on center, and longitudinal supports a maximum of 60 feet on center.

3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction. If the authorities having jurisdiction do not list an agency, at a minimum use an evaluation service member of ICC-ES or OSHPD, providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors

1. Refer to Section 05 05 23 – Metal Fastening.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

## 3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 11 13 – Facility Water Distribution Piping for piping flexible connections.

## 3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Engineer’s approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Where nonstructural component seismic certifications are required by Section 01 73 23 – Anchorage and Bracing of Nonstructural Components and this Section, provide manufacturer’s certification and installation guidelines.

5. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.

6. Test to 90 percent of rated proof load of device and anchorage.

7. Measure isolator restraint clearance.

8. Measure isolator deflection.

9. Verify snubber minimum clearances.

10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

## 3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

**END OF SECTION**

# SECTION 23 05 93
# HVAC BALANCING

## PART 1 – GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 01, apply to this Section.

### 1.02 SUMMARY

A. Section Includes

1. Balancing Air Systems

a. Constant-Volume Air Systems

b. Variable-Air-Volume Systems

### 1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rates and air patterns at the system or terminal level. At the system level, an example would be reducing fan speed; at the terminal level an example would be changing a damper position.

B. Balance: To proportion air or water flows within the distribution system, including submains, branches and terminals with respect to design quantities.

C. Balancing Agent: The entity responsible for performing and reporting the balancing procedures.

D. Balancing Specialist: An entity engaged to perform balancing work.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person’s skin than is normally dissipated.

F. Independent: Not affiliated with or in employment of the Contractor.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. Report Forms: Data sheets for recording data in logical order.

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I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. Terminal: A point where the controlled medium (fluid or energy) enters or leaves the distribution system.

## 1.04 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 23 00 00 – Basic HVAC Requirements

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC

D. Section 23 05 95 – HVAC Field Testing

E. Section 23 07 00 – HVAC Insulation

F. Section 23 08 00 – Commissioning of HVAC System

G. Section 23 09 01 – HVAC Automatic Temperature Controls (Relay Logic)

H. Section 23 31 13 – Metal Ducts and Duct Accessories

I. Section 23 34 00 – HVAC Fans

J. Section 23 74 05 – Positive Pressurization Units

K. Section 23 75 00 – Custom-Packaged HVAC Equipment

L. Section 23 81 26 – Split-System Air Conditioners

## 1.05 PROCEDURES

A. Testing and balancing of the equipment and systems of the facility shall be performed in the following order:

1. Equipment Checkout (See Specification 23 05 95 – HVAC Field Testing for testing requirements)

2. Equipment Testing (See Specification 23 05 95 – HVAC Field Testing for testing requirements)

3. Balancing

4. System Testing (See Specification 23 05 95 – HVAC Field Testing for testing requirements)

B. Balancing shall not be started until the Contractor has submitted and received approval on the Equipment Checkout and Equipment Testing of the respective equipment for the system being balanced.

C. Certified Data: The Contractor shall provide the Agency with the certified data on pumps, chillers and other equipment required for proper balancing of the system.

D. Adjustment: The Agency shall supervise or perform necessary adjustments to valves, pumps and other controls as required to properly balance the system.

E. Balancing: The Agency shall follow balancing procedures published by the AABC or NEBB.

F. Reports: Compile the data on report forms as listed in the AABC "National Standards for Total System Balance".

## 1.06 SUBMITTALS [NOT USED]

## 1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the Balancing Specialist and this Project's Balancing team members meet the qualifications specified in Article 1.08 Quality Assurance herein.

B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in PART 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit Balancing strategies and step-by-step procedures as specified in Article 3.02 Preparation.

D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in Article 3.02 Preparation.

E. Examination Report: Submit a summary report of the examination review required in Article 3.01 Examination.

F. Certified Balancing Reports: Within 21 days of completion of balancing work, submit AABC-certified Balancing Report.

G. Submit one copy of the final Balancing Report directly to the design professional of record. Provide five additional copies to the Contractor.

H. Sample report forms

I. Instrument calibration reports, to include the following:

1. Instrument type and make

2. Serial number

3. Application

4. Dates of use

5. Dates of calibration

## 1.08 QUALITY ASSURANCE

A. Refer to Section 23 00 00 – Basic HVAC Requirements and Section 23 08 00 – Commissioning of HVAC Systems regarding associated quality assurance and submittals requirements.

B. Qualifications

1. Balancing Agency: The Balancing aAgency shall be a Subcontractor of the Contractor and shall report to and be paid by the Contractor.

2. The Balancing Agency shall be either a certified member of AABC, TABB, or NEBB to perform Balancing services for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Agency loses subject certification during this period, the Contractor shall immediately notify the Engineer and submit another Balancing firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the 5 years preceding Contract Award shall not be eligible to perform any work related to the Balancing. All work performed in this Section and in other related Sections by the Balancing Agency shall be considered invalid if the Balancing Agency loses its

certification prior to Contract completion, and the successor Agency's review shows unsatisfactory work performed by the predecessor Agency.

3. Balancing Specialist: The Balancing Specialist shall be a certified member of AABC, TABB, or NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Resident Engineer and submit another Balancing Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, TABB, or the NEBB within the 5 years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including Balancing. All work specified in this Section and in other related Sections performed by the Balancing Specialist shall be considered invalid if the Balancing Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

4. Balancing Specialist shall be identified by the Contractor within 60 days after the Notice to Proceed. The Balancing Specialist shall coordinate, schedule and report all Balancing work and related activities and shall provide necessary information as required by the Engineer. The responsibilities specifically include:

    a. Directly supervise all Balancing work.

    b. Sign the Balancing Reports that bear the seal of the Balancing standard. The reports shall be accompanied by report forms and schematic drawings required by the Balancing standard, AABC, TABB, or NEBB.

    c. Follow all Balancing work through its satisfactory completion.

    d. Provide final permanent markings of settings of all HVAC adjustment devices.

    e. Permanently mark location of duct test ports.

5. All Balancing technicians performing actual Balancing work shall be experienced and must have done satisfactory work on a minimum of three projects comparable in size and complexity to this project. Qualifications must be certified by the Balancing Agency in writing. The lead technician shall be certified by AABC, TABB, or NEBB.

C. Balancing Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for balancing purposes.

D. Balancing Criteria

1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications", Chapter 38, and requirements stated herein shall be the basis for planning, procedures, and reports.

2. Flow Rate Tolerance: The following tolerances are allowed. All tolerances are based on the design flowrates listed in the Contract Documents. For tolerances not mentioned herein follow 2011 ASHRAE Handbook "HVAC Applications", Chapter 38, as a guideline. Air Filter resistance during balancing, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.

   a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): -0 to +10 percent.

   b. Air terminal units (maximum values): -2 to +10 percent.

   c. Exhaust hoods/cabinets: 0 to +10 percent.

   d. Minimum outside air: 0 to +10 percent.

   e. Individual room air outlets and inlets, and air flow rates not previously mentioned: -5 to +10 percent except if the air to a space is 100 cfm or less the tolerance would be -5 to +5 percent.

3. Systems shall be adjusted for energy efficient operation as described in PART 3.

4. Typical Balancing procedures and results shall be demonstrated to the Engineer for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the Engineer) and one hydronic system (pumps and three coils) as follows:

   a. When field Balancing work begins.

   b. During each partial final inspection and the final inspection for the Project if requested by Engineer.

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 – Air Balancing.

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 – System Balancing.

## 1.09 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire Balancing period. Cooperate with Owner during Balancing operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during Balancing operations to minimize conflicts with Owner's operations.

## 1.10 WARRANTY

A. Provide one of the following performance guarantees:

1. AABC National Project Performance Guarantee

2. NEBB Certificate of Conformance Certification

3. Balancing Quality Assurance Program Guarantee

4. TABB Project Performance Guarantee

B. Guarantee shall include provisions that the certified Balancing firm has balanced systems according to the Contract Documents and that the systems are balanced to optimum performance capabilities within design and installation limits.

# PART 2 – PRODUCTS

## 2.01 INSTRUMENT TEST HOLES

A. Permanent Test holes covers to be Ventlock #699.

B. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

## 2.02 INSULATION REPAIR MATERIAL

A. See Section 23 07 00 – HVAC Insulation. Provide for repair of insulation removed or damaged for Balancing work.

# PART 3 – EXECUTION

## 3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper balancing of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for balancing.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

E. Examine equipment performance data including fan and pump curves.

F. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and equipment with functioning controls is ready for operation.

G. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the Controls Subcontractor, and functioning.

H. Examine strainers to verify that Mechanical Subcontractor has replaced startup screens with permanent screens and that all strainers have been cleaned.

I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

J. Examine air vents to verify that Mechanical Subcontractor has removed all air from all hydronic systems.

## 3.02 PREPARATION

A. Prepare a Balancing plan that includes the following:

1. Equipment and systems to be balanced

2. Strategies and step-by-step procedures for balancing the systems

3. Instrumentation to be used

4. Sample forms with specific identification for all equipment

B. Prepare system-readiness checklists, as described in the AABC National Standards for Total System Balance, for use by systems installers in verifying system readiness for Balancing. These shall include, at a minimum, the following:

1. Airside

a. Ductwork is complete with terminals installed.

b. Volume, smoke and fire dampers are open and functional.

c. Clean filters are installed.

d. Fans are operating, free of vibration, and rotating in correct direction.

e. Variable-frequency controllers' start-up is complete and safeties are verified.

f. Automatic temperature-control systems are operational.

g. Ceilings are installed.

h. Windows and doors are installed.

i. Suitable access to balancing devices and equipment is provided.

## 3.03 GENERAL PROCEDURES FOR BALANCING

A. Perform balancing procedures on each system according to the procedures contained in the AABC National Standards for Total System Balance and in this Section.

1. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for balancing procedures.

2. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3. Adjust fan speeds by maximizing adjustable sheaves and pump impeller speeds if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, notify the Engineer.

4. Take report balancing measurements in inch-pound (IP) units.

## 3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare balancing reports for both fans and outlets. Obtain approved submittals and recommended balancing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check condensate drains for proper connections and functioning.

H. Check for proper sealing of air-handling-unit components.

## 3.06 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.

b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Report any artificial loading of filters at the time static pressures are measured.

3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.

2. Adjust sub-main and branch duct volume dampers for specified airflow. Re-measure each sub-main and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure airflow at all inlets and outlets.

3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after all have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

2. Re-measure and confirm total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, static profile.

4. Mark all final settings.

5. Run system in economizer mode. Verify proper operation and adjust, if necessary.

6. Measure and record all operating data.

7. Record final fan-performance data.

## 3.07 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located 2/3 of the distance down the duct from the fan discharge.

2. Verify that the system is under static pressure control.

3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-

unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows

    a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).

    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

    d. Adjust controls so that terminal is calling for minimum airflow.

    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

    f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.

    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After all terminals have been calibrated and balanced, adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.

    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.

    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

    d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.

   b. Measure static pressure directly at the fan inlet or through the flexible connection.

   c. Measure static pressure across each component that makes up the air-handling system.

   d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.

   b. Verify all terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to Controls Subcontractor.

9. Verify final system conditions as follows:

   a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

   b. Re-measure and confirm total airflow is within design.

   c. Re-measure all final fan operating data, rpms, volts, amps, static profile.

   d. Mark all final settings.

   e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.

   f. Verify tracking between supply and return fans.

## 3.08 PROCEDURES FOR MOTORS

A. Motors 1/2-hp and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number
2. Motor horsepower rating
3. Motor rpm
4. Phase/Hertz (Hz)
5. Nameplate and measured voltage, each phase
6. Nameplate and measured amperage, each phase
7. Starter size and thermal-protection-element rating
8. Service factor and frame size

B. Motors Driven by Variable-Frequency Controllers: Test the manual bypass of the controller to prove proper operation.

## 3.09 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

## 3.10 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: +/-10 percent
2. Air Outlets and Inlets: +/-10 percent
3. Heating-Water Flow Rate: +/-10 percent
4. Cooling-Water Flow Rate: +/-10 percent

B. Maintaining pressure relationships as designed shall have priority over the tolerances previously specified.

## 3.11 FINAL BALANCE REPORT

A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the balancing process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and results that appear in the reports must be made on site and dated by the AABC technicians or balancing engineers.

B. The report must be organized by systems and shall include the following information as a minimum:

1. Title Page

    a. AABC, TABB, or NEBB certified company name

    b. Company address

    c. Company telephone number

    d. Project identification number

    e. Location

    f. Project Architect

    g. Project Engineer

    h. Project Contractor

    i. Project number

    j. Date of report

    k. AABC or NEBB Certification Statement

    l. Name, signature, and certification number of AABC, TABB, or NEBB

2. Table of Contents

3. AABC National Performance Guaranty

4. Report Summary

    a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.

5. Instrument List

    a. Type

    b. Manufacturer

    c. Model

    d. Serial Number

    e. Calibration Date

6. Balancing Data

    a. Provide data for specific systems and equipment as required by the most recent edition of the AABC National Standards.

C. One copy of the final Balancing Report shall be sent directly to the design professional of record. Provide five additional copies to the Contractor.

## 3.12 VERIFICATION OF BALANCING REPORT

A. Final Verification

1. After balancing is complete and accurately documented in the final report, request that a final verification be made by design professional.

2. The Balancing Agency shall conduct the verification in the presence of Commissioning Authority.

3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final verification, the balancing shall be considered incomplete.

## 3.13 REVERIFICATION

A. Balancing Agency shall recheck all measurements and make adjustments as required to complete the balancing. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second verification.

B. If the second verification also fails, Owner may contact the applicable certification bureau.

## 3.14 ADDITIONAL BALANCING REQUIREMENTS

A. Seasonal Periods: If initial balancing procedures were not performed during near-peak conditions, the engineer may request a temperature recheck to further verify performance at near-peak conditions.

B. Sound Testing

1. After the systems are balanced and the spaces are architecturally complete, read and record sound levels at five locations as designated by the design professional of record.

2. Instrumentation

a. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.

b. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels and measuring the equivalent continuous sound pressure level (LEQ).

c. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 HZ to 8000 HZ.

d. The accuracy of the sound-testing meter shall be +/-1 decibel.

3. Test Procedures

a. Perform test at the quietest background noise period. Note any cause of unpreventable sound that may affect the test outcome.

b. Equipment should be operating at design values.

c. Calibrate the sound-testing meter prior to taking measurements.

d. Use a microphone suitable for the type of noise levels measured that is compatible with the meter. Provide a windshield for outside or in-duct measurements.

e. Record a set of background measurements in dB(A), and sound pressure levels in the eight un-weighted octave bands 63 to 8000 Hz (NC) with the equipment off.

f. Take sound readings in dB(A), and sound pressure levels in the eight un-weighted octave bands 63 to 8000 Hz (NC) with the equipment on.

g. Take readings no closer than 3 feet from a wall or from the operating equipment, and approximately 5 feet from the floor, with the meter held or mounted on a tripod.

h. For outdoor measurements, move the sound-testing meter slowly and scan the area that has the greatest exposure to the noise source being tested. (This type of reading is generally performed using the A-Weighted scale).

4. Reporting

a. The report must record: the location, the system tested, the dB(A) reading, and the sound pressure level in each octave band with equipment on and off.

b. Plot all the sound pressure levels on the NC worksheet, with the equipment on and off.

C. Vibration Testing

1. After the systems are balanced and the spaces are architecturally complete, read and record vibration levels on all equipment with motor horsepower equal to or greater than 10 hp.

2. Instrumentation

a. The vibration meter shall be portable, battery-operated, and microprocessor-controlled, with or without a built-in printer.

b. The meter shall automatically identify engineering units, filter bandwidth, amplitude and frequency scale values.

c. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.

3. Test Procedures

a. Verify that the vibration meter calibration date is current before taking readings.

b. To ensure accurate readings, verify that the accelerometer has a clean, flat surface and is mounted properly.

c. With the unit running, set up the vibration meter in a safe, secure location. Connect the transducer to the meter with the proper cables. Hold the magnetic tip of the transducer on top of the bearing and measure the unit in mils of deflection. Record the measurement, then move the transducer to the

side of the bearing, and record in mils of deflection. Record an axial reading in mils of deflection by holding the nonmagnetic, pointed transducer tip on the end of the shaft.

d. Change the vibration meter to velocity (inches per second) measurements. Repeat and record the previously listed measurements.

e. Record the CPM or the rpm.

f. Read each bearing on the motor, fan, and/or pump as required. Track and record vibration levels from the rotating component through the casing to the base.

4. Reporting

a. The report must record the location and the system tested.

b. Include horizontal-vertical-axial measurements for all tests.

c. Verify that vibration limits follow specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally “Smooth” to “Good.”

d. Include in the report the Machinery Vibration Severity Chart, with conditions plotted.

D. Controls Verification

1. In conjunction with system balancing perform the following:

a. Work with the Automatic Temperature Control (ATC) Subcontractor to ensure the system is operating within the design limitations, and gain a mutual understanding of intended control performance.

b. Confirm that the sequences of operation are in compliance with the approved drawings.

c. Verify that instruments and devices are calibrated and function as intended.

d. Verify that controller setpoints are as specified. Provide setpoints to ATC Subcontractor where required by the strategies such as fan/pump speeds and modulating damper positions to achieve design flows.

e. Verify the operation of all valve and damper actuators.

f. Verify that all controlled devices are properly installed.

g. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.

h. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidities, or pressures.

2. Reporting

a. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions

**END OF SECTION**

# SECTION 23 05 95
# HVAC FIELD TESTING

## PART 1 – GENERAL

### 1.01 REQUIREMENTS

A. The requirements of this Section apply to all sections of Division 23.

B. This Section specifies the requirements and procedures for field testing the HVAC systems. Requirements include developing a detailed testing plan and executing the testing plan to meet design requirements as indicated in this Section. Actions include but are not limited to measurement of the fluid quantities of the HVAC systems, operating HVAC equipment, proving control strategy requirements, and adjustments to meet control strategy requirements.

C. The testing and balancing of the equipment and systems of the facility shall be performed in the following order:

1. Equipment Checkout – Physical Checkout

2. Equipment Testing – Short Run Test

3. Balancing (See Section 23 05 93 – HVAC Balancing for balancing requirements)

4. System Testing – Full Controls Test and Control Strategy Proving

D. The Contractor shall submit and obtain approval for the Equipment Checkout and Equipment Testing prior to beginning balancing.

E. The Contractor shall submit and obtain approval for the HVAC System Balancing prior to beginning the System Test.

F. Where a system consists of multiple pieces of equipment (e.g., air handler and exhaust fans), all parts of the system shall have their Equipment Checkout and Equipment Testing submitted and approved before Balancing begins. Similarly, Balancing shall be completed, submitted, and approved for all system components before System Testing can begin.

1. Where this action would be deleterious or prohibitive to the system or component parts, the Contractor shall specifically include the reason in the Testing Procedure submittal and receive approval.

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G. The following HVAC systems shall be field tested:

1. Air Handling Equipment including integral and external fans

2. Air Cooling Systems

3. Air Heating Systems

4. Air Conveying Systems

5. HVAC Automatic Temperature Controls (ATC) Systems

H. This Section does not include specifications for materials for patching HVAC systems, or specifications for materials and installation of temporary devices. If devices must be added to achieve proper system testing or to execute the system control strategy, they shall be provided.

I. The respective equipment manufacturer's representative shall be present for Equipment Checkout and Equipment Testing activities. The representative shall sign all testing reports related to these portions of the testing report.

## 1.02 DEFINITIONS

A. Systems testing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes the balance of air distribution, water distribution, the adjustment of total system to provide design quantities, the electrical measurement, and the verification of performance of all equipment and automatic controls.

1. Test: To determine quantitative performance of equipment.

2. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

3. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

4. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

5. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

6. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets or supply outlets on air terminals and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

7. Main: Duct containing the system's major or entire fluid flow.

8. Submain: Duct containing part of the systems' capacity and serving two or more branch mains.

9. Branch Main: Duct serving two or more terminals.

10. Branch: Duct serving a single terminal.

## 1.03 SUBMITTALS

A. Submit the following in accordance with Division 01 requirements.

B. All testing shall be witnessed by the Owner or Engineer.

C. The Contractor shall submit a detailed testing procedure for approval. The Contractor shall have the testing procedure approved 30 days before testing is scheduled to begin. The detailed testing procedure shall include forms, procedures and diagrams for the Equipment Checkout, Equipment Test, and System Test procedures described in PART 3 of this Section. The testing procedure shall include:

1. Detailed step by step instructions as to how the equipment tests will be performed including but not limited to temporary layout modifications, any special procedures for testing equipment functionality, and how system actions will be activated.

2. All testing for systems that require seasonal outside air conditions shall be conducted when outside air conditions are suitable for such testing. When approved by the Engineer, the Contractor may conduct seasonal testing of the system during off-seasonal conditions. When this condition is approved, the report shall indicate how the test will accommodate testing of seasonal systems when seasonal conditions are not present.

3. A list of any additional or temporary equipment necessary to perform the tests such as pumps, heat exchangers, heating or cooling equipment.

4. A list of any instruments necessary to verify instrument signals in the HVAC system. The list shall include current calibration information. All instruments shall be within their calibration expiration at the date the testing is performed.

5. Provide tables for recording all required readings, action results, and comments.

6. Provide a checklist of items that will be checked during the test as listed in relative sections of PART 3 of this Section. Each action or step shall have a separate row. Each action or step shall be initialed by the Contractor’s Testing Technician conducting the test. All tests shall be signed and dated by the Contractor, the Testing Technician, and the Owner or Engineer. The Equipment Checkout and

Equipment Test shall also be signed by the respective equipment manufacturer's representative.

D. As each section of the Testing Procedure is completed, the Contractor shall compile and submit all signed results to the Owner for acceptance.

E. The equipment manufacturer's representative shall be present for all testing. The Equipment Checkout and Equipment Testing results shall include a letter from the Manufacturer's representative stating that the equipment has been installed per the Manufacturer's installation requirements and is in satisfactory working order.

F. Submit proof that the Testing Technician assigned to supervise the procedures, and the individual technicians proposed to perform the procedures meet the qualifications specified below.

G. The Contractor shall submit the signed results of the testing to the Owner for acceptance. The equipment manufacturer's representative shall be present for all testing. The results shall include a letter from the Manufacturer's representative stating that the equipment has been installed per the Manufacturer's installation requirements and is in satisfactory working order. Any deficiencies noted by the Manufacturer's representative shall be corrected and testing repeated.

1. The calibration data for all instruments used to verify HVAC system instrument readings shall be refreshed. All instruments shall be within their calibration expiration at the date the testing was performed.

## 1.04 QUALITY ASSURANCE

A. Testing Personnel Qualifications: The personnel responsible for testing the specified systems shall have at least 3 years of experience in testing systems similar to this project and shall be an employee of the installer or an independent testing agency.

B. Codes and Standards

1. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems

2. ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing

C. The Contractor shall provide all necessary instrumentation, tools, ladders, and labor etc. to complete all testing activities.

D. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

E. The 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.

F. The Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.

### 1.05 SEQUENCING AND SCHEDULING

A. Systems shall be fully operational prior to beginning procedures.

### 1.06 RELATED SECTIONS

A. Section 23 00 00 – Basic HVAC Requirements

B. Section 23 09 01 – HVAC Automatic Temperature Controls (Relay Logic)

C. Section 23 31 13 – Metal Ducts and Duct Accessories

D. Section 23 34 00 – HVAC Fans

E. Section 23 75 00 – Custom-Packaged HVAC Equipment

F. Section 23 82 16.14 – Electric-Resistance Air Coils

## PART 2 – PRODUCTS [NOT USED]

## PART 3 – EXECUTION

### 3.01 HVAC TESTING SEQUENCING

A. The HVAC testing shall be performed in the following sequence.

1. Pre-Start-up Inspection
2. Equipment Test
3. Balancing (See Section 23 05 93 – HVAC Balancing for balancing requirements)
4. Individual System Test
5. Whole HVAC System Run Test

B. HVAC Pre-Startup Inspection and Equipment Testing

1. All HVAC equipment shall have a Pre-Startup Inspection and Equipment test performed. The specific requirements for equipment indicated below shall be performed in addition to any requirements of the Manufacturer for startup and

initial operation. All other equipment shall be inspected per the Manufacturer's requirements and run for 1 hour trouble free.

2. The equipment manufacturer's representative shall be present for all testing.

3. Fans

   a. 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 belt tension

      5) Verify proper duct connections and accessories

      6) Verify that lubrication is completed

      7) Verify that equipment is in good condition and free from damage

      8) Verify that all packing materials, temporary stops, and temporary supports used during shipping have been removed

      9) Verify that equipment and associated ducts are free from debris

      10) Verify that equipment is installed per the Manufacturer's requirements

   b. Equipment Test

      1) Prior to energizing motor, verify and record voltage of power supply

      2) Bump motor to verify direction of rotation

      3) Run the fan for 1 hour of continuous trouble free operation. Any issues or stops required for tuning or repairs shall cause the test to be restarted from the beginning of this procedure.

      4) Monitor heat build-up in bearings. Bearing temperature shall not exceed the manufacturer's recommendations.

      5) Monitor for any abnormal noises or vibration. Abnormal noises and vibration shall be assessed and determined by the equipment manufacturer's representative.

      6) Check motor loads against nameplate data

7) Record fan sound levels 10 feet from the surface of the fan in 5-minute intervals during 1-hour run period. Sound levels shall be below 90 dB at all times.

C. Cooling Equipment (Refrigerant-Based)

1. Pre Startup Inspection

a. Verify proper equipment mounting and setting

b. Verify that control, interlock and power wiring is complete

c. Verify proper duct connections and accessories

d. Verify that lubrication is completed

e. Verify that equipment is in good condition and free from damage

f. Verify that all packing materials, temporary stops, and temporary supports used during shipping have been removed

g. Verify that equipment and associated ducts are free from debris

h. Verify that the refrigeration system has been evacuated and charged per the Manufacturer's requirements

i. Verify that equipment is installed per the Manufacturer's requirements

2. Equipment Test

a. Prior to energizing unit, verify and record voltage of power supply

b. Run the unit for 1 hour of continuous trouble-free operation, with no unexpected shutdowns, alarms or operational issues. Any issues or stops required for tuning or repairs shall cause the test to be restarted from the beginning of this procedure. If the ambient air temperature is too low to have the refrigeration system running constantly for 1 hour, the Contractor shall take into account any additional measures required to accomplish the testing based on the ambient air temperature. The Contractor shall provide any temporary heating equipment required to run this test including but not limited to temporary fans, ductwork, heaters, generators, heat exchangers, combustion equipment, and fuel storage and pumping at no cost to the project. Use of any heating equipment that was installed as part of this work shall not be permitted to be used as a heat source.

c. Monitor discharge and return air temperatures and compare to the manufacturer's submitted values.

d. Monitor for any abnormal noises or vibration. Abnormal noises and vibration shall be assessed and determined by the equipment manufacturer's representative.

e. Record fan sound levels 10 feet from the surface of the equipment in 5-minute intervals during 1-hour run period. The sound levels shall not exceed 90 dB.

3. Air Handling Units (Heating)

a. 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 belt tension

5) Verify proper duct connections and accessories

6) Verify that lubrication is completed

7) Verify that equipment is in good condition and free from damage

8) Verify that all packing materials, temporary stops, and temporary supports used during shipping have been removed

9) Verify that equipment and associated ducts are free from debris

10) Verify that equipment is installed per the Manufacturer's requirements

4. Equipment Test

a. Prior to energizing unit, verify and record voltage of power supply

b. Run the unit for 1 hour of continuous trouble-free operation with no unexpected shutdowns, alarms or operational issues in heating mode and for 1 hour of continuous trouble-free operation in ventilating mode. Any issues or stops required for tuning or repairs shall cause the test to be restarted from the beginning of the respective 1-hour test. Any safety trips will cause this testing to be restarted from the beginning of this procedure. If the ambient air temperature is too high to have the unit heating constantly for 1 hour, the Contractor shall adjust the setpoint temperature of the unit. The Contractor shall coordinate this testing with all other trades. The Contractor is responsible for scheduling this testing and shall take into account any additional measures required to accomplish the testing based on the

ambient air temperature. The Contractor shall not raise the temperature in the space to a point where it will cause damage to any equipment in the space or create unsafe or uncomfortable working conditions for the workers as determined by the Owner. If the Owner determines that the ambient conditions will not allow the testing of this equipment because the Contractor has scheduled the testing for a point in the season known to be warm, the Contractor shall provide any temporary cooling required to run this test including but not limited to temporary fans, ductwork, chillers, generators, cooling towers, make-up water supplies, heat exchangers, or air conditioners at no additional cost to the project.

c. Monitor heat build-up in bearings. Temperature shall not exceed the manufacturer's recommendations.

d. Monitor for any abnormal noises or vibration. Abnormal noises and vibration shall be assessed and determined by the equipment manufacturer's representative.

e. Check unit loads against nameplate data

f. Record fan sound levels 10 feet from the surface of the fan in 5-minute intervals during both 1-hour continuous operating periods.

D. Drip Pans

1. Drip pans and drains shall be hydrostatically tested under gravity of a filled drip pan and drain line for a minimum of 30 minutes. Any leaks shall be corrected, and the drip pan/drains retested until a watertight drip pan drainage system is confirmed.

E. Ductwork

1. All openings in the ductwork shall be temporarily sealed and the ductwork shall be pressurized and leak tested to demonstrate that the installation meets the specified SMACNA leakage class requirements. The Contractor shall follow SMACNA procedures for testing as outlined in SMACNA's HVAC Air Duct Leakage Test Manual.

F. Piping

1. Piping shall be tested as indicated in Section 23 23 00 – Refrigerant Piping.

## 3.02 INDIVIDUAL SYSTEM TESTING

A. The Contractor shall assist the ATC Subcontractor with individual system testing by operating the HVAC equipment. The Contractor shall coordinate with other trades as

required to complete the testing activities with minimal disruption to the owner's staff and operation of the facility.

B. All systems shall be tested to verify the system operates per the respective equipment specifications and control strategies. The testing shall systematically test all control functions including but not limited to all logic sequences, modes of operation, interlocks, alarms, safeties, adjustable setpoints, and instrument readings at all control panels.

## 3.03 REPAIR FOLLOWING TESTING PROCEDURES

A. All repair work shall be completed at no additional cost to the Owner.

B. Cut insulation and ductwork for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings using materials identical to those removed.

D. Seal ducts, test, and repair leaks created during the testing procedures on the hydronic and air systems.

E. Seal insulation to re-establish integrity of the vapor barrier at all locations where the vapor barrier was disturbed during the testing procedures.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with suitable permanent means of identification.

**END OF SECTION**

# SECTION 23 07 00
# HVAC INSULATION

## PART 1 – GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them.

C. Section 07 84 00 – Firestopping

D. Section 23 31 13 – Metal Ducts and Duct Accessories for duct liners

### 1.02 SUMMARY OF WORK

A. Work Included:

1. Flexible Glass Wool Blanket
2. Flexible Elastomeric Duct Insulation
3. Glass Wool Pipe Insulation
4. Flexible Elastomeric Pipe Insulation
5. Glass Mineral Wool Equipment Insulation
6. Jacketing
7. Accessories
8. Duct Insulation Accessories
9. Duct Insulation Compounds
10. Outdoor Ducting Cover

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced

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specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

2. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation

3. ASTM C921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

4. ASTM C1071A – Standard Specification for Fibrous Glass Duct Lining Insulation

5. ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

6. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

7. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials

## 1.04 SUBMITTALS

A. Shop Drawings: Submit for approval Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures showing the following:

1. Manufacturers' catalog literature, specifications, and illustrations with the following information:

   a. Thermal properties

   b. Physical properties (thickness, density, etc.)

   c. Fire hazard ratings

   d. Facing information

   e. Installation instructions

   f. Jointing recommendations for butt joints and longitudinal seam

   g. Fabrication instructions for duct fittings and valve insulation and coatings

2. Schedule of Project Specific Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated and for which type of duct or piping system it is associated with. Submit a tabular schedule for the entire Project.

3. Samples: For each type of insulation and field-applied jacket. Identify each Sample, describing product and intended use. Submit 8-inch square sections of each sample material.

4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

## 1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training. Company or firm that employs the insulation installers shall have a minimum of 5 years of experience in the business of installing HVAC-related duct and piping insulation systems.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Supply insulation products that assure excellent IAQ (Indoor Air Quality) performance through Greenguard Certification whenever possible.

E. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

G. Design Criteria: 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

H. Source Quality Control: Perform the following tests and inspections at the factory:

1. Flame spread

2. Smoke developed

3. Fuel contributed

I. Requirements of Regulatory Agencies

1. Permits: Contractor shall obtain and pay for all required fees, inspections and approvals by authorities having jurisdiction.

2. Building Codes: Comply with applicable requirements of all State and local building codes.

3. UL

4. NFPA

J. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified:

1. Federal Specification HH 1 558B – Insulation Blocks, Boards, Blankets, Felts, Sleeves, Duct Fitting Covering

2. ASTM C547

3. ASTM E84

K. Field Measurements: Take field measurements where required prior to installation to ensure proper fitting of work.

**1.06 PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Delivery of Material: Material shall be delivered to the job site in corrugated cartons.

B. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

C. Storage of Material

1. Store material in clean, dry area, out of the weather.

2. Material shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.

3. Material shall remain in original cartons until time of installation.

4. Insulation and Mold: Store all cartons of insulation elevated off the floor on pallets or wood blocking away from dust, dirt and debris. Store in a clean, dry, well-ventilated area. Carefully inspect any insulation that has been exposed to water. If insulation shows any sign of mold growth it must be discarded. If the material is

wet but shows no sign of mold, it should be dried rapidly and thoroughly. If it shows signs of facing degradation from wetting, it should be replaced. Mineral fiber based air handling insulation used in the air stream must be discarded if exposed to water regardless of signs of mold.

## 1.07 JOB CONDITIONS

A. 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 duct.

2. Insulating materials shall, at all times, be protected from moisture.

3. Material shall be warehoused on or near the job site and drawn from this protected area as used.

## 1.08 DEFINITIONS

A. Greenguard: Greenguard Environmental Institute, independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOCs), including formaldehyde and other specific product-related pollutants. Provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.

B. IAQ: Indoor Air Quality

C. EPA: Environmental Protection Agency

D. WHO: World Health Organization

E. ASJ: All Service Jacket

F. SSL: Self-Sealing Lap

G. FSK: Foil-Scrim-Kraft; jacketing

H. PSK: Poly-Scrim-Kraft; jacketing

## 1.09 COORDINATION

A. Schedule insulation application after testing duct and piping systems. Insulation application may begin on segments of duct or piping that has satisfactory test results. Do not install insulation prior to building interior being fully enclosed and weather tight.

B. Coordinate clearance requirements with duct and piping installers for insulation application.

C. Coordinate size and location of supports, hangers, and insulation shields specified in Section 40 05 07 – Pipe Supports.

D. Coordinate clearance requirements with piping Installer for piping insulation application duct Installer for duct insulation application, and equipment Installer for equipment insulation application.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. Flexible Glass Wool Blanket

1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning
5. Or approved equal

B. Flexible Elastomeric Duct Insulation

1. Armacell LLC Armaflex
2. K-Flex USA
3. Aeroflex USA
4. Or approved equal

C. Glass Wool Pipe Insulation

1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning
5. Or approved equal

D. Flexible Elastomeric Pipe Insulation

1. Insulation

    a. Armacell LLC Armaflex

    b. K-Flex

    c. Or approved equal

2. Glue

    a. Armacell LLC Armaflex Low VOC Adhesive

    b. K-Flex

    c. Or approved equal

3. Paint

    a. Armacell LLC Armaflex

    b. K-Flex

    c. Or approved equal

E. Cellular Glass

1. Pittsburgh Corning

2. Owens Corning

3. Or approved equal

F. Glass Mineral Wool Equipment Insulation

1. Certainteed

2. Johns Manville

3. Knauf

4. Owens-Corning

5. Or approved equal

G. Jacketing

1. ITW Insulation Systems
2. Johns Manville
3. GLT Products
4. Or approved equal

H. Accessories

1. ITW Insulation Systems
2. Johns Manville
3. GLT Products
4. Or approved equal

I. Duct Insulation Accessories

1. Certainteed
2. Johns Manville
3. Owens-Corning
4. Or approved equal

J. Duct Insulation Compounds

1. Certainteed
2. Johns Manville
3. Owens-Corning
4. Or approved equal

K. Outdoor Ducting Cover

1. Certainteed
2. Johns Manville
3. Owens-Corning

4. Or approved equal

## 2.02 FLEXIBLE GLASS WOOL BLANKET

A. ASTM C553, Type 1, Class B-2; flexible blanket

1. 'K' Value: 0.27 BTU*in/(hr*sf*F) at 75 degrees F installed, maximum service temperature of 250 degrees F

2. Density: 0.75 pounds per cubic foot

3. DBDE-free, UL/E validated to be formaldehyde-free

4. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL-Listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed

## 2.03 FLEXIBLE ELASTOMERIC DUCT INSULATION

A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet

1. Thermal Conductivity Value: 0.28 BTU*in/(hr*sf*F) at 75 degrees F

2. Maximum Service Temperature of 220 degrees F

3. Maximum Flame Spread: 25

4. Maximum Smoke Developed: 50 (1-inch thick and below)

5. Connection: Waterproof vapor retarder adhesive as needed

6. UV Protection: UV outdoor protective coating as needed per manufacturer's requirements

B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam

C. Paint: Nonhardening high elasticity type, manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather

## 2.04 GLASS FIBER PIPE INSULATION

A. Glass Wool: ASTM C547 Type I and IV; rigid molded, noncombustible

1. Thermal Conductivity Value: As indicated in the following insulation tables

2. Maximum Service Temperature: 850 to 1000 degrees F

B. Vapor Retarder Jacket: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic

## 2.05 FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet

1. Thermal Conductivity Value: As indicated in the following insulation tables

2. Maximum Service Temperature of 220 degrees F

3. Maximum Flame Spread: 25

4. Maximum Smoke Developed: 50 (1-inch thick and below)

5. Connection: Waterproof vapor retarder adhesive as needed

6. UV Protection: UV outdoor protective coating per manufacturer's requirements

B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam

C. Paint: Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather

D. For temperatures higher than 1200 deg F, change insulation specified as follows to ASTM C533, Type II, which is suitable for temperatures up to 1700 deg F

## 2.06 CALCIUM SILICATE PIPE INSULATION

A. Hydrous calcium silicate, tested in accordance with ASTM C533 Type I with minimum of 1200 PSI at 5 percent compression. Field applied jacket, Class II. Maximum 1200 degrees F temperature limit. Thermal conductivity as indicated in the following insulation tables.

## 2.07 CELLULAR GLASS PIPE INSULATION

A. Cellular Glass Insulation: Foamglass pipe insulation fabricated in accordance with ASTM C552 and ASTM C585. Thermal conductivity as indicated in the following insulation tables.

## 2.08 GLASS MINERAL WOOL EQUIPMENT INSULATION

A. Flexible Glass Mineral Wool Blanket: ASTM C612; flexible

1. Thermal Conductivity Value: As indicated in the following insulation tables

2. Maximum Service Temperature: 450 degrees F

## 2.09 JACKETING

A. Canvas Jacket: UL listed fabric, 6 ounce/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive

B. PVC preformed molded insulation covers. Zeston or approved equivalent

C. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory-attached protective liner

D. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth finish

## 2.10 ACCESSORIES

A. Equipment Insulation Jacketing: Pre-sized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated, coat with gypsum based cement

B. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

C. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories (i.e., adhesives, mastics, cements and tape) shall have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those previously listed herein. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

## 2.11 DUCT INSULATION ACCESSORIES

A. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated

## 2.12 DUCT INSULATION COMPOUNDS

A. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated

## 2.13 OUTDOOR DUCTING COVER

A. Aluminum Jacket: 0.016-inch-thick sheet, smooth/embossed finish, with longitudinal slip joints and 2-inch laps

B. Non-water vapor retarder, nonburning, weatherproof coating for use over insulation where "breathing" is required

C. UV resistant polyvinyl chloride covering with joints secured and sealed

## PART 3 – EXECUTION

### 3.01 GENERAL INSTALLATION REQUIREMENTS

A. Verification of Conditions

1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.

2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Preparation: Clean and dry surfaces to be insulated.

C. Installation

1. Insulation: Continuous through walls, floors and partitions except where noted otherwise

2. Piping and Equipment

a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.

b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position seam on bottom of pipe.

D. Provide accessories as required. See Article 2.10 – ACCESSORIES herein.

E. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

F. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 09 90 00 – Painting.

G. Ductwork

1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.

2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.

3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.

4. Coat staples and seals with vapor barrier coating.

5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 2 inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.

6. Fill jacket penetrations (i.e., hangers, thermometers and damper operating rods, and other voids) in insulation with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate hangers and supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.

7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.

8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.

9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.

H. Insulated Pipe Exposed to Weather: Where piping is exposed to weather, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Install metal jacket with 2-inch overlap at longitudinal and butt joints with exposed lap pointing down. Secure jacket with stainless steel draw bands 12 inches on center and at butt joints.

I. Insulation Shields: Provide hangers and shields (18-gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch-long, non-compressible insulation section at insulation shields for lines 2 inches and larger (hot and cold) piping.

J. Ductwork Surfaces to be Insulated

| Item to be Insulated | System Insulation Type | Duct Size | Insulation Thickness (inches) |
|---|---|---|---|
| Supply ductwork where duct is not specified to be lined. | Flexible Glass Blanket/ Flexible Elastomeric | All | 1.5 |
| Return ductwork where duct is not specified to be lined. | Flexible Glass Blanket/ Flexible Elastomeric | All | None |
| Supply ductwork (exposed to weather, in crawl space and in unheated attics) | Flexible Glass Blanket/ Flexible Elastomeric | All | 3 |
| Return ductwork (exposed to weather, in crawl space and in unheated attics) | Flexible Glass Blanket/ Flexible Elastomeric | All | 3 |
| Outside Air Ducts | Flexible Glass Blanket/ Flexible Elastomeric | All | 3 |
| HVAC plenums and unit housings not preinsulated | Duct Liner | All | 1.5 |
| Exhaust ducts within 10 feet of exterior | Flexible Glass Blanket/ Flexible Elastomeric | All | 3 |
| Exposed insulation in mechanical rooms or areas subject to damage | Flexible Glass Blanket/ Flexible Elastomeric | All | 1.5 |

Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

K. Piping Surfaces to be Insulated

| Item to be Insulated | System Insulation Type | Conductivity Range (Btu-inch per hour per SF per degrees F) | Pipe Size (Inches) | Insulation Thickness (Inches) |
|---|---|---|---|---|
| Refrigerant Suction Piping (40F to 60F) | Flexible Elastomeric | 0.21 to 0.27 at a mean rating temperature of 75 degrees F | <1<br>1 to <1.5<br>1.5 to <4<br>4 to <8<br>>= 8 | 0.75<br>0.75<br>1.0<br>1.0<br>1.0 |
| Refrigerant Suction Piping (<=40F) | Flexible Elastomeric | 0.20 to 0.26 at a mean rating temperature of 50 degrees F | <1<br>1 to <1.5<br>1.5 to <4<br>4 to <8<br>>= 8 | 1.0<br>1.5<br>1.5<br>1.5<br>1.5 |
| Breeching, Thermal Heater Exhaust | Calcium Silicate | 0.52 to 0.58 at a mean rating temperature of 500 degrees F | All | 4.0 |

Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

## 3.02 FLEXIBLE GLASS WOOL BLANKET

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local

Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code.) Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2 inches. On ducts over 24 inches wide, additionally secure insulation with suitable mechanical fasteners at 18 inches on center. Circumferential and longitudinal joints stapled with flare staples 6 inches on center and covered with 3-inch wide, foil reinforced tape.

## 3.03 FLEXIBLE ELASTOMERIC DUCT INSULATION

A. Install insulation in conformance with manufacturer's recommendations and requirements.

## 3.04 GLASS WOOL PIPE INSULATION

A. See General Installation Requirements previously listed herein.

B. Install insulation in conformance with manufacturer's recommendations and requirements.

C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.

D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

## 3.05 FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Flexible Elastomeric Insulation

1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and below grade with two coats of finish as recommended by manufacturer.

B. Flexible Elastomeric Tubing

1. Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.

C. See General Installation Requirements previously listed herein.

D. Install insulation in conformance with manufacturer's recommendations and requirements.

E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.

F. Install in accordance with manufacturer's instructions for below grade installation.

## 3.06 CALCIUM SILICATE

A. Install in accordance with manufacturer's instructions. Seal canvas jacket tight to insulation at lap joints. Continuous insulation over pipe, fittings and supports or hangers. No gaps permitted.

B. See General Installation Requirements previously listed herein.

C. Install in accordance with manufacturer's instructions for below grade installation.

## 3.07 CELLULAR GLASS

A. See General Installation Requirements previously listed herein.

B. Install in accordance with manufacturer's instructions.

C. Foamglass Insulation: Install in accordance with manufacturer's instructions for below grade installation and exposed weather installation with jacketing.

D. Install in accordance with manufacturer's instructions for below grade installation.

## 3.08 GLASS MINERAL WOOL EQUIPMENT INSULATION

A. See General Installation Requirements previously listed herein.

B. Install in accordance with manufacturer's instructions.

C. Storage Tanks: Cover with glass mineral wool, 2 inches thick. Finish with canvas jacket and adhesive. Overlap joints minimum of 4 inches. Apply two coats latex paint; color selected by Architect.

## 3.09 JACKETING

A. See General Installation Requirements previously listed herein.

B. Install in accordance with manufacturer's instructions.

## 3.10 ACCESSORIES

A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.

B. See General Installation Requirements previously listed herein.

C. Provide and install accessories for all insulation types listed in this Section.

## 3.11 DUCT INSULATION ACCESSORIES

A. Install insulation in conformance with manufacturer's recommendations and requirements.

## 3.12 DUCT INSULATION COMPOUNDS

A. Install insulation in conformance with manufacturer's recommendations and requirements.

## 3.13 OUTDOOR DUCTING COVER

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Outdoor Duct Exposed to Weather

1. Install jacket with brakes/slope to prevent standing water on duct. Use weatherable components.

2. Weatherproof seal at joints and seams. Minimum 2-inch overlap.

3. Label jacket every 6 feet and within 2 feet of building penetrations and equipment connections: "Do not stand or place equipment on duct."

**END OF SECTION**

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# SECTION 23 08 00
# COMMISSIONING OF HVAC SYSTEMS

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. This Work includes commissioning of selected building systems. The complete list of equipment and systems to be commissioned is specified in Section 01 75 00 – Checkout and Startup Procedures. The commissioning process, which the Contractor is responsible for executing, is defined in Section 01 75 00 – Checkout and Startup Procedures. A Commissioning Agent (CxA) hired by the Contractor shall manage the commissioning process.

### 1.02 RELATED WORK

A. Section 00 72 00 – General Conditions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 75 00 – Checkout and Startup Procedures

### 1.03 SUMMARY

A. This Section includes requirements for commissioning the Thermal Dryer Facility exterior closure, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 75 00 – Checkout and Startup Procedures.

B. Refer to Section 01 75 00 – Checkout and Startup Procedures for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

### 1.04 DEFINITIONS

A. Refer to Section 01 75 00 – Checkout and Startup Procedures for definitions.

### 1.05 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems in accordance with the requirements of Section 01 75 00 – Checkout and Startup Procedures and of Division 23, is required in cooperation with the Owner and the Commissioning Agent.

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B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 75 00 – Checkout and Startup Procedures.

## 1.06 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the Owner prior to forwarding to the Contractor. Refer to Section 01 33 00 – Submittal Procedures for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 75 00 – Checkout and Startup Procedures.

## 1.07 HEATING, VENTILATING, BUILDING AUTOMATION SYSTEMS (BAS), AND TAB WORK

A. The commissioning tasks applicable to the mechanical, BAS and TAB work of Division 23 are as follows (all references apply to equipment to be commissioned only):

1. Construction and Acceptance Phase Requirements

a. Submittal data, commissioning documentation, and O&M data.

b. Attend all commissioning meetings.

c. Provide shop drawings of equipment to be commissioned along with completed & signed Pre-Functional checklists.

d. Document start-up and functional testing procedures including:

1) Manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, Owner-contracted tests, fan and pump curves, all factory testing reports, and all warranty information.

e. Table of Contents with listing of all equipment that will be included in the O&M manuals for review and approval.

f. Specific functional performance test procedures.

g. Alarm limits to be used during the tests.

h. Start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists for all equipment to be commissioned. Submit to Owner's Representative for review and approval prior to startup. Refer to Section 01 75 00 – Checkout and Startup Procedures for further details on start-up plan.

i. Prior to startup and initial checkout process, execute the mechanical prefunctional checklists for all equipment to be commissioned.

j. Perform and clearly document all system operational checkout procedures and completed startup, promptly providing a copy to the Owner as components are completed and systems are debugged and completed.

k. Correct all punch list items before functional testing.

l. Air and water TAB shall be completed with discrepancies and problems remedied before requesting Owner witnessing functional testing.

m. Functional Performance Tests/Procedures may be used to perform adjustments prior to witnessing by the Engineer and Owner.

n. Complete functional performance testing for specified equipment in Section 01 75 00 – Checkout and Startup Procedures.

B. Assist the Owner in interpreting the monitoring data.

1. Correct deficiencies as interpreted by the Contractor and Engineer and retest the equipment prior to Functional Performance Witnessing by the CxA. Coordinate scheduling of Functional Performance Witnessing with the Contractor and Owner.

2. Provide all Documentation, Plans, Reports, Notes, Output from Electronic Commissioning Tools, and other analysis tools to the Owner promptly upon successful Functional Test witnessing.

3. Update O&M manuals according to the Contract Documents.

4. Document specific requirements to maintain the validity of the warranty.

## 1.08 WARRANTY PERIOD

A. Execute seasonal or deferred functional performance testing, witnessed by the Owner.

B. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 GENERAL REQUIREMENTS

A. This Section establishes general requirements pertaining to HVAC commissioning of building systems, equipment and appurtenances.

B. Commissioning is intended to achieve the following specific objectives of the Contract Documents.

1. Verify and document proper installation and design parameters of equipment, systems, and integrated systems.

2. Ensure that operating and maintenance and commissioning documentation requirements are complete.

3. Provide Owner with functional buildings and systems that meet the Contract Documents and Owner’s operational requirements at Substantial Completion.

C. The Contractor shall deliver a successful commissioning process. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents and the specified Owner's operational requirements. During commissioning, the Contractor shall systematically demonstrate to the Owner that the operable systems are properly performing in strict accordance with the Contract Documents and Owner requirements.

1. Commissioning requires cooperation and involvement of all parties throughout the construction process.

2. Successful commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion, with the exception of deferred tests approved in advance by the Owner’s Representative.

3. Commissioning will encompass and coordinate traditionally separate functions of: system documentation, Inspection, Pre-functional Checklists and start-up, control system calibration and point-to-point checkout, Testing, Adjusting, and Balancing, Functional Performance Tests, Integrated System Tests, and Contractor demonstration to the Owner. This requires assembling all related documentation into one Commissioning Manual.

4. Interim Reports and Final Commissioning Manual shall be submitted in electronic, fully searchable, portable document format (.pdf), for review and approval by the Owner's Representative and the Owner.

5. Design Review by Cx Provider: Prior to the Construction-phase, the Cx-Provider shall perform a design review at 50% and 95% CD stages of project. They examine the contract documents and comment on design concepts, suitability for the project, adherence to the OPR, Owner's standards and specifications, O&M requirements and industry best practices.

D. Certify that HVAC systems, BAS, subsystems, and equipment have been installed, calibrated, and started and operating according to the Contract Documents, manufacturer's specifications, Owner's standards and specifications, and approved Shop Drawings and submittals.

E. Certify that HVAC instrumentation and control systems have been installed and calibrated, that they are operating according to the Contract Documents, Owner's standards and specifications, and approved Shop Drawings and submittals, and that pretest set points have been recorded.

F. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

G. Set systems, subsystems, and equipment into operating modes to be tested according to approved test procedures. Modes required to be tested include normal start-up, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.

H. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

I. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

J. Construction Checklists: Prepare and submit detailed construction checklists for HVAC systems, subsystems, equipment, and components.

K. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Owner's Representative, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Owner's Representative and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.

3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

L. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

M. Include seasonal testing. Complete appropriate initial performance tests and documentation and schedule seasonal tests.

N. Coordinate schedule with and perform the following activities at the direction of Engineer.

O. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.

P. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests

2. Demonstration of a sample of performance tests

3. Commissioning tests

4. Commissioning test demonstrations

Q. Construction Meetings: The Cx Agent conducts regular meetings during construction to identify and assist in resolving issues, including, but not limited to, submittal reviews, BAS sequences, construction quality deficiencies, Owner's standards adherence, receipt of as-built drawings and schedule concerns.

1. Commissioning Construction List tracking – shall include a list of items to be resolved, date identified, required action, responsible party and date resolved.

R. Final Cx Report. The Cx Agent provides a Final report within 6 months of building occupancy. Report shall include:

1. Executive Summary

2. Construction List

3. Commissioning checklists

4. BAS as-built drawings

5. Operations Manual

6. TAB report

S. Quality Assurance. Commissioning procedures shall be in accordance with NEBB, ASHRAE, AEE or BCxA. Commissioning agent is certified by one of these groups.

## 3.02 CONSTRUCTION INSPECTIONS

A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 75 00 – Checkout and Startup Procedures and the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

## 3.03 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Owner and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 01 75 00 – Checkout and Startup Procedures for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

## 3.04 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 00 72 00 – General Conditions. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

## 3.05 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 75 00 – Checkout and Startup Procedures for additional details.

**END OF SECTION**

**SECTION 23 09 01**

**HVAC AUTOMATIC TEMPERATURE CONTROLS (RELAY LOGIC)**

## PART 1 – GENERAL

### 1.01 REQUIREMENTS

A. The ATC Subcontractor shall furnish and install all HVAC Automatic Temperature Controls (ATC) components and accessories in accordance with the Specifications.

B. HVAC equipment and controls shall be furnished and installed to operate as a system. The ATC Subcontractor shall coordinate all requirements between Manufacturers to insure unit responsibility and compatibility of the equipment and controls.

C. All labor, material, and equipment not specifically referred to herein or on the plans, which are required to meet the functional intent of this Section, including the integration to existing applications and reporting, shall be provided without additional cost to the Owner.

D. ATC control systems indicated on the Drawings or Specifications and control devices such as thermostats, etc. indicated to be 24 volts or less shall be supplied, mounted, wired, and terminated by the ATC Subcontractor. The ATC Subcontractor shall size and provide low-voltage transformers where required.

E. Wiring and Conduit

1. All 480V 3-phase wiring and conduit as well as all 120V power supply wiring and conduit to HVAC control panels shall be provided under Division 26 – Electrical by the Electrical Subcontractor.

2. 120V and 24V control wiring and conduits between HVAC Control Panels and other HVAC control panels, field devices, instruments, and dampers shall be provided, installed and terminated by the ATC Subcontractor.

3. Conduit and wires between HVAC control panels and non-HVAC equipment and control panels (SCADA, FACP, etc.) shall be provided under Division 26 - Electrical and provided by the Electrical Subcontractor. Wire terminations in HVAC Control panels shall be by the ATC Subcontractor and terminations for non-HVAC control panels shall be provided by the Electrical Subcontractor. Wiring and terminations shall meet all requirements of Division 26.

## 1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. The ATC Subcontractor shall submit shop drawings on all equipment, accessories, and appurtenances and all fabrication work or other mechanical and air conditioning work required.

2. Include all Specification Section technical exceptions in the submittal. The manufacturer agrees that the equipment is in compliance with Specification Sections that are not identified in the list of technical exceptions.

3. Submit documentation in the following phased delivery schedule:

    a. Control equipment hardware

    b. System schematics, including:

        1) Sequence of operation

        2) Point names

        3) Point to point wiring

        4) Interface wiring diagrams

        5) Panel layouts

        6) System Diagrams

        7) Logic Diagrams

4. All instruction books and manuals.

5. Closeout Submittals: Warranty documentation

6. The ATC Subcontractor shall submit heat generation calculations for each panel. The calculations shall take into account the panel construction and equipment installed within and shall show if natural heat transfer through the panel walls is sufficient or if supplemental cooling is required.

    a. Ambient conditions for indoor panels in air-conditioned spaces shall assume 85°F unless otherwise noted.

    b. Ambient conditions for indoor panels in un-air-conditioned areas shall assume 104°F unless otherwise noted.

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c. Ambient conditions for outdoor panels shall assume 120°F unless otherwise noted.

7. Upon completion of the work, provide a complete set of ‘as-built’ control drawings in AutoCAD file format.

8. The ATC Subcontractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01. Operation and Maintenance Manuals shall be submitted for all equipment as follows:

   a. Index sheet, listing contents in alphabetical order

   b. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams

   c. Description of sequence of operations

   d. As-Built interconnection wiring diagrams

   e. List of connected points, including panels to which they are connected and input device (ionization detector, sensors, etc.)

   f. Conduit routing diagrams

   g. Copy of the warranty

   h. Operating and maintenance manuals and instructions

   i. Recommended spare parts list

## 1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under the provisions of Contract Documents.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.

D. Protect openings in casing and seal them with plastic wrap to keep dirt and debris. Protect coils from entry of dirt and debris with pipe caps or plugs.

E. Air Terminal Unit/VAV Actuator and Unitary Controllers: The ATC Subcontractor shall furnish actuators for all motorized dampers on VAV boxes requiring actuated dampers.

The Contractor shall coordinate and arrange for actuators and DDC unitary controller to be shipped to air terminal unit factory for factory mounting.

## 1.04 MANUFACTURER'S INSTRUCTIONS

A. Installation of all equipment shall be in accordance with Manufacturer's data.

B. All changes from the installation procedures in manufacturers' data shall be submitted for approval in accordance with the requirements for shop drawings.

C. Keep all Manufacturers' data provided in a secure manner at the job site at all times. Catalog and index this data for convenient reference.

D. Manufacturers' data shall be available for the information of the Owner and the use of other trades.

E. Turn over all data to the Owner at completion of the Work and final testing.

F. Submit all instruction books and manuals in accordance with Division 01.

## 1.05 SCHEDULES ON DRAWINGS

A. In general, all capacities of equipment and characteristics are as indicated in schedules on the Drawings. Reference shall be made to the schedules for such information. The capacities indicated are minimum capacities. Variations in capacities of the scheduled equipment supplied under this Contract will be permitted only with the written direction of the Engineer.

## 1.06 CODE, PERMIT AND STANDARDS

A. Resolve any code violation discovered in contract documents with the Owner prior to award of the contract. After award of the contract, make any correction or additions necessary for compliance with applicable codes at no additional cost to the Owner.

B. The ATC Subcontractor shall obtain and pay for all permits and shall comply with all laws and codes that apply to the Work.

C. The ATC Subcontractor shall be responsible for all added expense due to their choice of equipment, materials, or construction methods.

D. All work and materials shall be in full accordance with the latest State rules and regulations or publications including those of the state of Georgia and/or Cherokee County Fire Marshall, the Mechanical Code, and all local codes. Nothing in the Drawings and/or Specifications shall be construed to permit work not conforming to the previously listed codes, rules and regulations.

E. Referenced Standards

1. ASTM

a. D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

2. ISA

a. S5.1 – Instrumentation Symbols and Identification

b. iS5.4 – Standard Instrument Loop Diagrams

3. NEMA

a. 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

4. NFPA

a. 70 – NEC

5. UL

## 1.07 QUALITY ASSURANCE

A. Installer Qualifications (ATC Subcontractor): All work described in this Section shall be installed, wired, circuit tested and calibrated by the ATC Subcontractor's factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with the Manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the Manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

B. Manufacturer Qualifications (ATC Manufacturer): Company specializing in manufacturing the products specified in this Section with minimum 5 years documented experience, who issues complete catalog data on total product.

C. All material and equipment shall be the latest design, new, not deteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.

D. When two or more units of the same class of material or equipment are required, they shall be products of a single Manufacturer.

E. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the Manufacturers and in accordance with specified codes and standards.

F. Touch up and/or repaint to match original finishes for factory finished or painted equipment and materials which are scratched or marred during shipment or installation shall be performed as follows:

1. Immediately after installation, sand smooth any rusted or damaged areas of shop paint and primer.

a. Furnish air-drying touch-up paint and compatible air-drying primer to be applied by the Contractor.

## 1.08 ACRONYMS USED IN THIS SECTION

A. ATC – Automatic Temperature Control

B. FACP – Fire Alarm Control Panel

C. LCP – Local Control Panel

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. Provide a relay-based control system to execute the required control strategy.

B. The ATC system shall be comprised of stand-alone control panels and stations and other devices as specified herein.

C. The Drawings shall be taken as diagrammatic. The Contractor shall field check the existing site for detailed dimensions and clearances for preparation of shop drawings. Design sizes of ducts and their locations are indicated, but not every offset, fitting, or structural obstruction is indicated.

D. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided, unless specifically noted otherwise.

## 2.02 CONTROL PANELS

A. Enclosures

1. Enclosure NEMA rating and material shall be furnished in accordance with Section 26 05 33.16 – Boxes for Electrical Systems – Part 2, section – Pull and Junction Boxes – Enclosure Types and Materials.

2. NEMA 4X, Type 304 Stainless Steel

    a. Enclosures shall be NEMA 4X Type 304 stainless steel construction with a minimum thickness of 14 gauge for all surfaces (except those areas requiring reinforcement) having a smooth brushed finish. Enclosure shall have a manufacturer included internal grounding connection. The grounding screw shall not penetrate through the exterior of the enclosure.

    b. Wall mounted panels shall be furnished with Type 304 stainless steel quick-release clamp assemblies on three sides of each door. Floor mounted panels shall be furnished with Type 304 stainless steel, 3-point, lockable door latch with Type 304 stainless steel handles.

    c. A lockable hasp shall be provided for all panels that have quick-release clamps assemblies.

    d. Panels shall be furnished with rolled lip around three sides of the door and along top of enclosure opening.

    e. Panels shall be provided with clear plastic, gasketed lockable hinged door to encompass all non-NEMA 4X front panel devices.

3. NEMA 12, Painted Steel

    a. Enclosures shall be NEMA 12, carbon steel construction with a minimum thickness of 14 gauge for all surfaces (except those areas requiring reinforcement) with powder coat painted interior and exterior. The enclosure shall have an internal grounding connection.

    b. Wall mounted panels shall be furnished with metallic quick-release clamp assemblies on three sides of each door. Floor mounted panels shall be furnished with metallic, 3-point, lockable door latch with metallic handles.

    c. A lockable hasp shall be provided for all panels that have quick-release clamps assemblies.

    d. Panels shall be furnished with rolled lip around three sides of the door and along top of enclosure opening. All welds shall be ground smooth.

4. NEMA 1, Painted Steel

    a. Enclosures shall be NEMA 1, carbon steel construction with a minimum thickness of 14 gauge for all surfaces (except those areas requiring reinforcement) with powder coat painted interior and exterior. The enclosure shall have an internal grounding connection.

b. Wall mounted panels shall be furnished with metallic clamp assemblies on three sides of each door. Floor mounted panels shall be furnished with metallic, 3-point, lockable door latch with metallic handles.

c. A lockable hasp shall be provided for all panels that have quick-release clamps assemblies.

d. Panels shall be furnished with rolled lip around three sides of the door and along top of enclosure opening. All welds shall be ground smooth.

5. NEMA 4X Fiberglass or PVC

a. Enclosures shall be impact resistant, non-conductive, hot compression molded fiberglass reinforced polyester or injection molded PVC.

b. Wall mounted panels shall be furnished with Type 304 stainless steel latch assemblies. Floor mounted panels shall be furnished with metallic, 3-point, lockable door latch with metallic handles. Panels shall be lockable.

c. Type 304 stainless steel piano hinge

d. Gasket shall be poured polyurethane seamless gasket.

B. Enclosure Lighting and Convenience Receptacle

1. All panels shall be furnished with one 120VAC, 15A duplex, grounding type convenience power receptacle and 120 VAC fluorescent light or LED fixture. Lights shall have a minimum of 470 lumen lamp and plastic protective shield. A minimum of one lamp shall be provided for every 9 sq ft of panel face area.

2. The power receptacle and fluorescent light shall have a dedicated circuit breaker.

3. All lights shall be controlled by a single snap switch which will turn all the lights on and off. The switch shall be installed in an outlet box with cover and located to be easily accessible. The switch shall be labeled as the “Control Panel Interior Light Switch”.

C. Wiring

1. Wiring shall conform with requirements of Division 26.

D. Relays

1. Mechanically held, socket type, oil tight, heavy-duty type contactors (relays) for DIN rail mounting. Miniature relays are not acceptable. Relays shall be rated as required by the design with a minimum contact rating of 10A. The relay shall be provided with the number of poles required by the design and one spare Type C dry contact.

2. Timing relays and relays shall be Allen Bradley – Series 700, Omron MK-S, Square D 8501 Type R, or equal.

E. Indicating Lights, Switches, Buttons, Terminal Blocks

1. Shall be provided in accordance with Section 26 09 16 – Electric Controls and Relays.

F. Panel Tags, Nameplates, and Signage

1. All tags, nameplates, and signage on the face of the panel shall be plastic engraved plates. Plates shall be a minimum of 1/16” thick. All plates shall be rated for outdoor use and be suitable for UV exposure. The engraved portions shall be painted with a high contrast fill for easy readability of the plate.

2. Panels located in corrosive areas shall have plates and paint suitable for the corrosive in the space and shall not degrade due to exposure. Any tags that corrode or experience color change, warping, chipping, or flaking of the plate or paint shall be replaced at no cost to the Owner.

3. Panel mounted plates shall be secured to panels using an industrial adhesive.

4. Wall mounted plates shall be secured using stainless steel hardware.

## 2.03 FIELD DEVICES

A. Provide automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide Manufacturer’s standard control system components as indicated by published product information, designed and constructed as recommended by Manufacturer.

B. Electronic Actuators

1. Operating Temperature range shall be from -20 to 200ºF (-29 to 90ºC).

2. The actuator shall be provided with open and close limit switches. The open limit switch shall be adjustable.

3. Provide damper position indicator. The indicator is not required to be visible on the exterior of NEMA 4X and NEMA 7 actuator enclosures.

4. Size each actuator to operate dampers with sufficient reserve power to provide smooth modulating action or 2-position action as specified.

5. Actuators shall be direct coupled type.

6. All actuators shall fail closed by an integrated spring return system unless specifically indicated otherwise by the Drawings. The actuator shall be capable of providing clockwise or counterclockwise fail-safe operation based on the required mounting.

7. Actuators shall be protected from overload at all angles of rotation.

8. Actuators shall be UL approved.

9. The actuators shall be constructed to meet the requirements for double insulation so an electrical ground is not required to meet agency listings.

10. All dampers shall receive power from the respective HVAC ventilation control panel that they serve.

11. Actuator NEMA rating shall match the rating indicated on the Control Flow Diagrams for the space in which it is located. Where actuators are not available in the designated NEMA rating, enclosures shall be provided by the damper actuator to achieve the required NEMA rating.

C. Thermostats

1. Thermostats for VAV boxes and Heating Coil control shall be of the programmable type. Thermostats shall be capable of having a 7-day/week program entered with separate occupied and unoccupied setpoints and schedules for each day.

2. Thermostats shall have a means to adjust the space temperature setpoint on the thermostat.

3. Thermostat shall have a display capable of showing the current space temperature, space temperature setpoint, schedule, heating/cooling mode, and the current time.

4. Thermostat communication shall be coordinated with the VAV or BMS system for operation of the VAV, heating coil hot water valve, or other controlled equipment.

D. Flow Switch

1. Provide flow switches of the thermal dispersion type.

2. The switch enclosure shall be constructed of Type 316 stainless steel and rated NEMA 4X. All parts exposed to the air stream shall be Type 316 stainless steel.

3. Probe length shall be coordinated with location. The ATC Subcontractor shall locate the device as follows unless specifically prohibited by the sensor Manufacturer's installation instructions:

    a. The device shall be located per the Manufacturer's installation requirements. Where Manufacturer's do not provide installation instructions, the device shall be located away from the edges of the duct as close to the middle as is practical while still maintaining access. Unless indicated otherwise by the Manufacturer's installation instructions, the device shall extend between 1/4 and 1/3 of the way into the duct.

4. All flow switches indicated in the Control Flow Diagrams are dual element sensors which shall be used at a single point in the ductwork. Each flow sensing location shall consist of two sensing elements. The ATC Subcontractor shall use a sensor that has a module for accepting multiple signals and outputs a single flowrate value. As an alternative for manufacturers that do not offer multipoint communication, the ATC Subcontractor shall accept signals from each individual sensor directly into the BMS and provide programming to provide a single flow reading based on the individual sensor readings.

5. The instrument shall be powered by the respective HVAC control panel that the sensor serves or by external power as indicated on the Drawings. When powered by a control panel, the ATC Subcontractor shall coordinate the sensor voltage with the panel fabricator.

6. Flow sensors for NEMA 7 spaces shall be rated for Class I, Division 1 locations.

7. Flow sensors for NEMA 12 and NEMA 4X locations shall be rated NEMA 4X.

8. Flow sensors shall be Fluid Components International model FLT93 (Basis of Design) or equal.

E. Air Differential Pressure Switch

1. Sensors shall have field selectable ranges.

2. Sensor shall have local readout of the current differential pressure.

3. Sensor shall be capable of outputting a discrete alarm from a local differential pressure setpoint.

4. NEMA rating of the sensor shall be suitable for the NEMA rating of the space as indicated on the Control Flow Diagrams.

5. Pressure sensing line shall be Type 316 stainless steel 3/8" tubing. Exterior sensing lines shall be protected from wind with a capped with a removable screen fitting.

F. Alarm Strobe and Siren

1. Unclassified Spaces

a. All devices shall be UL listed, NEMA 4X rated, and designed for hazardous indoor and outdoor locations where corrosive vapors are present.

b. Strobe shall have a flashing LED array. The strobe shall generate 60 flashes per minute. The Strobe shall have a minimum candela of 1000 with a lamp life of 60,000 hours.

c. The siren shall have built in gain control and be capable of generating an alarm tone within an adjustable range of 0dBA to 110dBA at a distance of 10 feet. Any controllers or modules required to generate the alarm tone shall be provided by the same manufacturer as the siren. The Contractor shall coordinate with the Owner for the specific tone to be used.

G. Duct Smoke Detectors

1. Provide smoke detectors in accordance with NFPA 90A and as indicated on the Drawings. Provide UL listed or FM approved detectors for duct installation.

2. Provide duct detectors with an approved duct housing, mounted exterior to the duct, and with perforated sampling tubes extending across the width of the middle of the duct. All detectors shall be furnished with remote key operated test stations.

3. Provide an access door in the ductwork for inspection and maintenance.

4. Duct smoke detectors for classified locations shall be the air aspiration addressable type designed for remote sensor location for ducts with difficult service access. The detector and housing shall be located on the wall of an adjacent unclassified space as indicated on the Drawings. Sample tubes shall be installed in rigid aluminum conduit for protection.

5. Duct smoke detectors for unclassified locations shall be installed on the ductwork as indicated in the Drawings. Detectors shall be addressable type in NEMA 4 enclosure.

6. All duct smoke detectors shall have the following:

a. The detectors shall operate at air velocities from 300 to 4,000 feet per minute.

b. Visual indication of alarm must be provided on the detector front and mounted at a 30-degree slant to provide a wide viewing angle. A manual reset/test switch shall be located on the front of the device. A remote reset/test function shall be provided for all smoke detectors.

c. Detector heads shall not require additional filters or screens which must be maintained. The housing shall contain a detector base which shall accept photoelectric or ionization heads. Terminal connections shall be provided for remote alarm indication and remote reset/test switches. All wiring must comply with local codes and regulations.

d. Duct detectors located higher than 6 feet above the floor shall be provided with remote keyed test stations.

7. Duct detectors for classified spaces shall be Gamewell – FASST series or approved equal. Duct detectors for unclassified spaces shall be Gamewell – DNRW series or equal.

8. Where fire alarm systems are being installed by the Fire Alarm Subcontractor, duct smoke detectors shall be provided by and installed by the HVAC Subcontractor. The HVAC Subcontractor shall be solely responsible for ensuring submitted duct detectors are compatible with the provided fire alarm system. See Specification 28 46 20 – Fire Alarm Systems for additional requirements.

## 2.04 SUPPLEMENTAL ENCLOSURE COOLING

A. Where additional cooling is indicated by the heat generation calculations, the panels shall be equipped with one of the following methods of supplemental cooling. All supplemental cooling methods shall be powered from the respective control panels unless specifically indicated otherwise.

1. NEMA 3R Enclosures

a. Air to Air Heat Exchanger

b. Air Conditioning

c. Filtered Fan Ventilation

2. NEMA 12 Enclosures

a. Air to Air Heat Exchanger

b. Air Conditioning

c. Filtered Fan Ventilation

3. NEMA 4X Enclosures

a. Air to Air Heat Exchanger

b. Air Conditioning

c. Washdown Rated Filtered Fan Ventilation

4. NEMA 7 Enclosures

a. Air Conditioning

B. Air to Air Heat Exchanger

1. Rated NEMA 12, 3R, 4X to suit enclosure rating

2. Stainless steel construction

3. Epoxy coated aluminum core

4. 10-micron ambient side intake air filter

C. Filtered Fan Ventilation

1. Rated NEMA 12 or 3R to suit enclosure rating

2. Enclosure shall be fitted with intake and exhaust grilles

3. Polypropylene intake filter

4. Metal mesh exhaust filter

## 2.05 TOOLS, SUPPLIES, AND SPARE PARTS

A. Furnish all special tools, supplies and spare parts necessary to install, disassemble, service, and repair the equipment.

B. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number. Spare parts shall be packed in individual, suitable containers clearly labeled with the part number; name, quantity, and the equipment for which they are intended.

D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the OWNER.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Install system and materials in accordance with Manufacturer's instructions, and as detailed on the Drawings.

B. All wiring shall be labeled with BRADY style wire markers at each end.

C. Provide signal conditioning devices and surge protection devices for Controllers, Control Panels and peripherals.

D. Drawings of temperature control systems are diagrammatic only and any apparatus not indicated, such as relays, accessories, etc., but required to make the system operative to the complete satisfaction of the Owner shall be furnished and installed at no additional cost to the Owner.

### 3.02 ACCEPTANCE TESTING

A. Upon completion of the installation, the ATC Subcontractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these Specifications.

B. The ATC Subcontractor shall perform tests to verify proper performance of components, logic, and alarms. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the system operation.

C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of the Owner, as required. Properly schedule these tests so testing is complete at a time directed by the Owner. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

### 3.03 WARRANTY

A. For a period of 1 year from the date of Substantial Completion, the ATC Subcontractor warrants to the Owner that the ATC System conforms to these Specifications and is free from defects in materials and workmanship. The ATC Subcontractor shall repair or replace, at the sole option of and at no additional cost to the Owner, any work found to be defective within said warranty period. Such repair or replacement shall include the cost of removal and reinstallation.

1. Within this period, upon notice by the Owner, any defects in the ATC System due to faulty materials, methods of installation, or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the ATC Subcontractor at no expense to the Owner.

2. The Owner will grant to the ATC Subcontractor reasonable access to the ATC System during the warranty period.

B. The ATC Subcontractor shall obtain from the Manufacturer its warranty that the ATC System will be free from defects in design (if applicable), materials, and workmanship for a period of 1 year. Said warranty, containing no exclusions or limitations, shall be in a form acceptable to, and for the benefit of the Owner and shall be submitted by the ATC Subcontractor as condition of final payment.

## 3.04 SEQUENCE OF OPERATION

A. Control Panel HVCP-TDF shall control make-up air unit MAU-TDF-1 exhaust fans EF-TDF-1 and EF-TDF-2, supply fan S-TDF-1, and control dampers CD-TDF-1, CD-TDF-2, and CD-TDF-3.

B. Thermal Dryer Room

1. Exhaust Fan – On/Off (EF-TDF-1, EF-TDF-2)

a. Run Conditions – Interlocked: The fans EF-TDF-1 and EF-TDF-2 shall be interlocked to run whenever Air Handling Unit MAU-TDF-1 runs unless shutdown on safeties.

b. Fan: The fan shall run continuously when operating.

c. Run Conditions: The unit shall run according to a user definable time schedule in the following modes:

1) Occupied – Summer Mode:

a) When the outdoor temperature is above 50 degrees F, the unit shall run at 100% of the rated airflow.

2) Unoccupied – Winter Mode:

a) The fan shall be at 50% of the rated airflow whenever the outdoor temperature is below 50 degrees F and the space is unoccupied, as determined by the lighting interlock and the combustible gas monitoring system is within the allowable limits.

d. Exhaust Air Damper: The exhaust air damper shall open any time the unit runs and shall close any time the unit stops. The exhaust air damper shall close 30 sec (adj.) after the fan stops.

e. Alarms shall be provided as follows:

1) Damper Failure: Commanded open, but the status is closed.

2) Damper in Hand: Commanded closed, but the status is open.

f. Fan Status: The controller shall monitor the fan status.

g. Alarms shall be provided as follows:

1) Fan Failure: Commanded on, but the status is off.

2) Fan in Hand: Commanded off, but the status is on.

3) Loss of airflow

2. Makeup Air Unit – Zone Air Temp (MAU-TDF-1)

a. Run Conditions - Scheduled: The unit shall run according to a user definable time schedule in the following modes:

1) Occupied Mode: The unit shall maintain a 60°F (adj.) heating setpoint.

2) Unoccupied Mode (winter): The unit shall maintain a 55°F (adj.) heating setpoint.

b. Alarms shall be provided as follows:

1) High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.)

2) Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.)

c. Zone Setpoint Adjust: The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

d. Freeze Protection: The unit shall shut down and generate an alarm upon receiving a freezestat status.

e. Smoke Detection: The unit shall shut down and generate an alarm upon receiving a smoke detector status.

f. Outside Air Damper: The outside air damper shall open any time the unit runs and shall close any time the unit stops. The supply fan shall start only after the damper status has proven the damper is open. The outside air damper shall close 4 sec (adj.) after the supply fan stops.

g. Alarms shall be provided as follows:

1) Outside Air Damper Failure: Commanded open, but the status is closed

2) Outside Air Damper in Hand: Commanded closed, but the status is open

h. Supply Fan: The supply fan shall run any time the unit is commanded to run. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime, unless shutdown on safeties.

1) The supply fan shall operate in the following modes:

a) Occupied – Summer Mode: When the outdoor temperature is above 50 degrees F, the unit shall run at 100% of the rated airflow.

b) Unoccupied – Winter Mode: The fan shall be at 50% of the rated airflow whenever the outdoor temperature is below 50 degrees F and the space is unoccupied, as determined by the lighting interlock, and the combustible gas monitoring system is within the allowable limits.

i. Alarms shall be provided as follows:

1) Supply Fan Failure: Commanded on, but the status is off

2) Supply Fan in Hand: Commanded off, but the status is on

3) Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.)

4) Loss of airflow

j. Gas Heating Stages: The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

k. The heating shall be enabled whenever:

1) Outside air temperature is less than 65°F (adj.)

2) AND the zone temperature is below the heating setpoint

3) AND the fan status is on

l. Filter Differential Pressure Monitor: The controller shall monitor the differential pressure across the filter.

m. Alarms shall be provided as follows:

1) Filter Change Required: Filter differential pressure exceeds a user definable limit (adj.).

n. Discharge Air Temperature: The controller shall monitor the discharge air temperature.

o. Alarms shall be provided as follows:

1) High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.)

2) Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.)

C. Thermal Heater Room

1. Supply Fan – Cooling (SF-TDF-1)

a. Run Conditions - Continuous: The unit shall be continuously enabled to maintain a zone temperature cooling setpoint of 85°F (adj.).

b. Alarms shall be provided as follows:

1) High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).

c. Fan: The fan shall run any time the zone temperature rises above cooling setpoint, unless shutdown on safeties.

d. Intake Air Damper: The intake air damper shall open any time the unit runs and shall close any time the unit stops. The intake air damper shall close 30 sec (adj.) after the fan stops.

e. Filter Differential Pressure Monitor: The controller shall monitor the differential pressure across the filter.

f. Alarms shall be provided as follows:

1) Filter Change Required: Filter differential pressure exceeds a user definable limit (adj.)

g. Damper Status: The fan shall be enabled after the damper status has been proven.

h. Alarms shall be provided as follows:

1) Damper Failure: Commanded open, but the status is closed

2) Damper in Hand: Commanded closed, but the status is open

i. Fan Status: The controller shall monitor the fan status.

j. Alarms shall be provided as follows:

1) Fan Failure: Commanded on, but the status is off

2) Fan in Hand: Commanded off, but the status is on

2. Combustion Air Dampers (CD-TDF-4, CD-TDF-5)

a. Combustion Air Dampers: The combustion air dampers shall open any time the Thermal Fluid Heater is called to run and shall close any time the Thermal Fluid Heater stops. The combustion air intake air dampers shall close 30 sec (adj.) after the Thermal Fluid Heater stops. End of travel switches shall verify the dampers are open or closed.

3. Electrical Room

a. Split System DX Cooling Air Source Heat Pump (AC-TDF-1, AC-TDF-2, ACCU-TDF-1 and ACCU-TDF-2): Run Conditions - Scheduled: The units shall run according to a user definable time schedule in the following modes:

1) Occupied Mode: The unit shall maintain:

a) An 80°F (adj.) cooling setpoint

b) A 65°F (adj.) heating setpoint

2) Unoccupied Mode (night setback): The unit shall maintain:

a) An 85°F (adj.) cooling setpoint

b) A 55°F (adj.) heating setpoint

3) Alarms shall be provided as follows:

a) High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.)

b) Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

4) Zone Setpoint Adjust: The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

5) Smoke Detection: The unit shall shut down and generate an alarm upon receiving a smoke detector status.

6) Fan: The fan shall run any time the unit is commanded to run, unless shutdown on safeties.

7) Heating and Cooling - 1 Compressor Stage: The controller shall measure the zone temperature and cycle the compressor to maintain the setpoint of the associated thermostat. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime. The compressor shall run subject to its own internal safeties and controls.

    a) The heating shall be enabled whenever: outside air temperature is less than 60°F (adj.) AND the fan is on AND the reversing valve is in heat mode.

    b) The cooling shall be enabled whenever outside air temperature is greater than 65°F (adj.) AND the fan is on AND the reversing valve is in cool mode.

8) On mode change, the compressor shall be disabled and remain off until after the reversing valve has changed position.

9) Alarms shall be provided as follows:

    a) Compressor Runtime Exceeded: The compressor runtime exceeds a user definable limit (adj.)

10) Discharge Air Temperature: The controller shall monitor the discharge air temperature.

11) Alarms shall be provided as follows:

    a) High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.)

    b) Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.)

12) Fan Status: The controller shall monitor the fan status.

13) Alarms shall be provided as follows:

    a) Fan Failure: Commanded on, but the status is off

b) Fan in Hand: Commanded off, but the status is on

c) Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.)

**END OF SECTION**

# SECTION 23 23 00
# REFRIGERANT PIPING

## PART 1 – GENERAL

### 1.01 SECTION INCLUDES

A. The Contractor shall provide copper and brass pipe and fittings as indicated. This Section includes all copper and brass pipe and fittings, including all insulation, painting and related work as shown on the Contract Drawings, specified in the Specifications or required for a complete installation.

### 1.02 RELATED SPECIFICATIONS

A. Section 40 05 00 – Basic Mechanical Requirements

### 1.03 PAYMENT

A. Payment will be made as provided for in the Specifications.

B. No direct payment will be made for painting, insulation and testing pipelines or for gaskets, bolts, nuts and other appurtenances and material required to erect the lines; the costs thereof shall be included in the prices bid for the pipe.

### 1.04 REFERENCES

A. ASTM B16 – Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.

B. ASTM B32 – Solder Metal.

C. ASTM B42 – Seamless Copper Pipe, Standard Sizes.

D. ASTM B43 – Seamless Red Brass Pipe, Standard Sizes.

E. ASTM B61 – Steam or Valve Bronze Castings.

F. ASTM B62 – Composition Bronze or Ounce Metal Castings.

G. ASTM B88 – Seamless Copper Water Tube.

H. ASTM B124 – Copper and Copper Alloy Forging Rod, Bar and Shapes.

I. ASTM B251 – Wrought Seamless Copper and Copper-Alloy Tube.

J. ASTM B280 – Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

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K. ASTM B302 – Threadless Copper Pipe.

L. ASME B1.20.1 – Screw Threads – Pipe Threads, General Purpose (Inch).

M. ASME B16.15 – Cast Bronze Threaded Fittings, Classes 125 and 250 (Includes Revisions Service).

N. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings (Includes Revision Service).

O. ASME B16.22 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fitting (Includes Revision Service).

P. ASME B16.24 – Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500 and 2500.

Q. MSS SP-58 – Pipe Hangers and Supports – Materials, Design, and Manufacture.

R. MSS SP-69 – Pipe Hangers and Supports – Selection and Application.

S. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.

T. ASME Code, Section VIII, Appendix bb.

## 1.05 DESIGN REQUIREMENTS

A. Copper and brass pipe and fittings shall conform to the latest Building Code of the State or Commonwealth in which the project is located in respect to plumbing and other applications covered by these laws.

B. Copper and brass pipe shall conform to the latest standards of the American Society for Testing and Materials (ASTM), the American National Standards Institute (ANSI), the American Society of Mechanical Engineers (ASME), the Copper and Brass Research Association (CABRA), the Society of Automotive Engineers (SAE), the Manufacturer's Standardization Society (MSS), the American Welding Society (AWS), and National Pipe Thread (NPT).

## 1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 01 of the Specifications.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The following manufacturers are acceptable. Equivalent products from other manufacturers may be submitted for approval.

B. Copper Pipe and Fittings:

1. Pipe and Fittings:

a. Mueller Industries, Inc., Wichita, KS.

b. IBCO, Elkhart, IN.

c. Or equal.

2. Flared Tube Fittings:

a. Parker Hannifin Corp., Triple-Lok Fittings.

b. NIBCO, Elkhart, IN.

c. Or equal.

C. Brass Pipe and Fittings:

1. Metalloy Industries, Inc., Alachua, FL.

2. NIBCO, Elkhart, IN.

3. Or equal.

D. Wall Sleeve Annular Seals:

1. Thunderline Corp. (Link-Seal), Belleville, MI.

2. The Metraflex Corporation, Metraseal, Chicago, IL.

3. Flexicraft Industries (The Pipe Seal), Chicago, IL.

4. Or equal.

E. Insulation:

1. Armstrong World Industries, Inc.

2. Rubatex Corp.

3. Or equal.

## 2.02 PIPE MATERIALS

A. Copper Pipe and Fittings

1. Refrigeration Piping: For refrigeration copper pipe, provide type ACR seamless, round, hard drawn copper tubing that meets ASTM B280 requirements. The pipe shall be delivered to the site clean, charged with nitrogen, and sealed. Provide tube sizes, dimensions and wall thickness conforming to ASTM B280 for Type ACR tubing, unless otherwise specified. Provide nominal lengths of hard copper tubing in straight lengths of approximately 20 feet, unless otherwise specified.

    a. Fittings: For copper tubing, use brazed joint socket type fittings, as specified. No bending of hard copper tubing will be permitted, unless otherwise specified; make all bends and connections with suitable fittings.

        1) Braze Joint Fittings: Provide ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and copper alloy fittings. Braze joint fittings and tubing in conformity with the specifications of Section 3 of the CABRA Copper Tube Handbook. Brazing alloy shall be copper-phosphorus alloy, Class BCuP-5, as specified by American Welding Society Spec. AWS A5.8.

2. Drain Copper Piping: For drain copper pipe, provide type L seamless, round, hard drawn copper tubing that meets ASTM B88 requirements. Provide tube sizes, dimensions and wall thickness conforming to ASTM B88 for Type L tubing, unless otherwise specified. Provide nominal lengths of hard copper tubing in straight lengths of approximately 20 feet, unless otherwise specified.

    a. Fittings: Provide solder type fittings of the same material as the pipe.

    b. Joints: Use ASTM B32 alloy Grade 95TA (95 percent tin and 5 percent antimony) solder for piping.

3. Potable Water Piping: Use ASTM B32 alloy Grade 95TA (95 percent tin and 5 percent antimony) solder for piping carrying potable water.

4. Unacceptable Uses: Do not use copper pipe with soldered joints for transporting fuel oil or other flammable or toxic liquids inside buildings.

B. Wall Sleeves

1. Unless otherwise shown or specified, furnish and install suitable pipe sleeves at all points where pipes pass through walls or floors of structures. Sleeve material shall

be steel unless indicated otherwise on the Contract Drawings or specified in the Specifications.

C. Wall Sleeve Annular Seals

1. Where pipes pass through walls, partitions or floors where fire-rated construction is not required, provide modular mechanical type seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall sleeve. Provide an elastomeric element that is of the size, quantity, type and material that the manufacturer recommends for the intended service and that will provide an effective hydrostatic seal. Bolts and nuts shall be stainless steel. Wall sleeve annular seals shall be approved equal to those manufactured by the companies listed in Paragraph 2.01.D.

2. For all penetrations through fire-rated walls, partitions and floors, provide a permanent fire stop system. The fire stop system shall maintain the integrity of the wall or floor system for the rated time period and shall allow normal pipe movement without being displaced. The fire stop system shall be intumescent when exposed to flame or heat. Asbestos shall not be used as fire stop material.

D. Corrosion Resistant Coating

1. All copper pipe shall receive a corrosion resistant coating. For piping that receives insulation, the coating shall be applied and allowed to cure per the manufacturer's instructions prior to insulating.

2. Coating shall be a field applied Bronz-Glow's SPC-Clear coating, Incralac or approved equal. The coating shall be specifically listed for use on copper pipe for the protection from corrosion due to hydrogen sulfide and shall be UV resistant.

## 2.03 INSULATION MATERIALS

1. Refer to Section 23 07 00 – HVAC Insulation

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Install all pipe and fittings in accordance with this Specification and as shown on the Contract Drawings, and in accordance with the manufacturer's recommendations and approved shop drawings.

B. Connections Between Dissimilar Metals in Pipes: Where connections are to be made between pipelines or equipment of dissimilar metals, make the connections using dielectric insulating couplings, unions or other approved dielectric insulating devices.

C. Connections Between Dissimilar Metals in Supports: Where contact between dissimilar metals between pipes and supports, or supports and the structure occur, the site of the contact shall be suitable protected using a dielectric media to prevent the contact between the surfaces such as a neoprene pad.

D. Pipe Lengths: Full standard lengths of pipe shall be used in each pipe run in so far as possible. Shorter lengths than standard shall be used only to complete a straight run of pipe, to connect to established locations of valves, equipment, bends, and the like. Random lengths of pipe or cuttings from standard lengths shall not be coupled together when a full standard pipe length will fit in the pipe run.

E. Piping for refrigeration shall remain charged with nitrogen and sealed until it is installed. The Contractor shall take precautions to ensure that the pipe is clean and free from debris.

F. The Contractor shall provide a flow of nitrogen through the piping and fittings during brazing to prevent the formation of scale.

G. Reducing Fittings: Use reducing fittings for all changes in pipe size. Do not use bushings.

H. All copper piping shall receive a corrosion resistant coating. The coating shall be applied within 24 hours of the pipe passing the leak test. The copper pipe shall be thoroughly cleaned prior to application of the coating. At a minimum, the pipe shall be free of all signs of corrosion, oils, flux, and other substances that will hinder proper application of the coating. The Contractor shall follow all cleaning and pipe preparations required by the coating Manufacturer.

I. All refrigeration piping and all interior condensate piping shall be insulated with 1.5” of elastomeric insulation and provided with an aluminum jacket. The insulation shall be applied after the corrosion coating has fully cured as indicated by the coating manufacturer.

J. Pipe Flexibility

1. Make ample provisions for flexibility in all pipelines.

2. Install branch tees on risers in locations that will allow the branch lines, when expanded by heat, to drain properly.

3. Unless other forms of expansion compensation are specified, such as expansion joints, fabricate all runs of pipe subject to change in length shorter than their theoretical length to the extent of one half of the expansion and erect them such that they may be free to expand without increasing the stresses imposed when cold.

4. When the foregoing method of compensation for expansion is not adequate, furnish and install in the pipelines expansion devices adequate to allow the lines to expand and contract freely without injury to any part of the piping system. The devices may be in the form of expansion joints, swivel joints, swing joints, pipe bends or flexible couplings, and shall include such anchors as may be shown or required to make the devices effective. A sufficient number of fittings and pipe lengths shall be used in connection with swing joints to assure the absence of distortion of either the pipelines or branches. Application guide and anchor requirements for expansion joints shall be in accordance with the recommendations of the manufacturer or the Standards of the EJMA.

K. Venting

1. Each high point in liquid lines shall be provided with a vent consisting of an automatic air release/vacuum relief valve and an outlet vent line. The automatic valve and vent line for pipelines up to and including 1-inch size shall be the same size as the carrier pipe. In larger carrier pipes, the valve and vent line shall be of the size given in the Specifications, but not smaller than 1 inch. The automatic valve shall have a cast or ductile iron body and cover, stainless steel internals, and Viton or Buna N seal, unless otherwise specified. The outlet vent line from the valve shall be Schedule 80 CPVC, and shall terminate at a point approximately 3 feet above the floor. A bronze ball valve shall be provided between the carrier pipe and the automatic valve to allow removal of the automatic valve for repair or replacement.

2. Where vent valves are so located that liquids discharged therefrom would cause damage to structure or equipment, the vent shall be piped to the nearest gutter or drain in an approved manner.

L. Drainage

1. Each low point in liquid lines shall be provided with not less than a 1-inch drain line. A bronze ball valve shall be provided at the connection to the carrier pipe and at the terminus approximately 3 feet above the floor. A quick connect coupling shall be provided at the end of the drain line for attachment of a hose. The drain line shall be Schedule 80 CPVC.

M. Hangers and Supports: Furnish and install all supporting devices. The hangers and supports shall conform to the requirements of MSS SP-58, 69, and 89.

N. Drip Pans: Provide drip pans under all metallic pipelines installed over electrical equipment and motors to conduct drainage to the nearest floor drain, gutter or other drainage system with 3/4-inch red brass pipe. Make the connection between the drip pan and the brass drain pipe leaktight, and pitch the drip pan uniformly toward the drain pipe at a slope not less than 1/8-inch per lineal foot.

O. Pipe identification signs and valve identification numbers shall be furnished and installed in conformity with Section 40 05 97 – Piping and Equipment Identification Systems.

## 3.02 CLEANING AND TESTING

A. Cleaning: During construction, clean all piping before placement and keep the lines free from every kind of foreign matter. All pipelines shall be left thoroughly clean to the satisfaction of the Engineer. Flush all process and potable water pipelines with clean water.

B. Test all pipelines for leakage in conformance with Section 40 05 00 – Basic Mechanical Requirements.

C. Refrigerant piping must be tested before any piping is insulated, coated, or concealed. The entire refrigerant circuit must be thoroughly tested to be sure that it is absolutely tight. The system shall be tested with oil pumped dry nitrogen. The low side of a 410a system shall be tested at 375 psig and the high side at 420 psig. Other refrigerant test pressures shall match the respective test pressures used by the manufacturer of the evaporator and condenser coils. All pipe joints shall be tapped sharply with a rubber mallet and tested for leaks with a soap solution. After all leaks have been repaired, the system shall be charged with a small quantity of refrigerant and the entire system shall be checked with a detector suitable for the type of refrigerant. Once the system is found tight, it shall be allowed to stand for 6 hours with the pressure on. If any pressure drop occurs, except those due to changes in ambient temperature, the entire system shall be retested. The system shall be evacuated with a vacuum pump to a minimum vacuum of 1 mm Hg absolute is achieved or as prescribed by the equipment manufacturer, whichever is more stringent. Under no circumstances shall the compressor be used to evacuate the system. After evacuation, the system shall be allowed to stand for 12 hours. If no noticeable rise in pressure occurs, the system shall be charged.

D. Condensate piping shall be tested under pressure of a filled line. The discharge shall be temporarily plugged and the line filled with clean water. All joints shall be visually inspected. Any leaks shall be corrected and the line retested. Condensate piping located outside shall not be tested when the temperature is below freezing.

## 3.03 DISINFECTION

A. Disinfect all potable water pipelines in accordance with Section 40 05 00 – Basic Mechanical Requirements.

**END OF SECTION**

# SECTION 23 31 13
# METAL DUCTS AND DUCT ACCESSORIES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all ductwork, fittings, and accessories as shown on the Drawings and in accordance with the Specifications.

B. The equipment shall be furnished complete with all accessories, special tools, base attachments, mountings, anchor bolts and other appurtenances as specified or as may be required for a complete installation.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 00 00 – Basic HVAC Requirements

B. Section 23 05 48 – Vibration and Seismic Controls HVAC

C. Section 23 05 93 – HVAC Balancing

D. Section 23 05 95 – HVAC Field Testing

E. Section 23 07 00 – HVAC Insulation

### 1.03 SUBMITTALS

A. The Contractor shall submit shop drawings on all new and modified ductwork, accessories and appurtenances and all fabrication work required for all equipment specified in this Section in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall submit shop drawings for supports for new and modified ductwork. The shop drawings shall locate and identify each support, brace, hanger, guide, component and anchor. Ductwork support systems shall be designed and Shop Drawings prepared and sealed by a Professional Engineer registered in the state of Georgia and shall comply with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components and Section 23 05 48 – Vibration and Seismic Controls for HVAC. Include sealed calculations used to support the final support design.

C. The Contractor shall submit shop drawings for support of multi-section dampers and louvers. The shop drawings shall identify all supports and reinforcement required to allow the multi-section dampers and louvers to be rated for the maximum pressure of the individual damper and louver sections. The support system shall be designed and calculations prepared and sealed by a Professional Engineer registered in the state of Georgia.

12-04-2024

## PART 2 – PRODUCTS

### 2.01 GENERAL REQUIREMENTS

A. All work shall be constructed and installed in a first-class workmanlike manner in accordance with the recommendations given in the latest edition of the SMACNA HVAC Duct Construction Standards and Round Industrial Duct Construction Standards, unless otherwise specified.

B. All ductwork shall be constructed in accordance with the Schedule of Duct Construction Standards at the end of this Section. Transverse duct connections shall be bolted, gasketed connections.

C. All ducts shall conform accurately to the dimensions indicated on the Drawings, shall be straight and smooth on the inside with neatly finished joints, and shall not be decreased at any point to avoid obstructions. No piping, conduit or structural work shall be installed in or through any ductwork. All ductwork shall be run as close as possible to structural members, walls and ceilings. Duct work shall be as shown on the dDrawings, subject to such modifications as may be necessary to suit field conditions.

D. Where existing walls, floors or roofs must be penetrated, the Contractor shall neatly cut the required openings and patch the existing work to provide a neat and finished appearance.

E. All ducts shall be made reasonably tight throughout and shall have no openings other than those required for the proper operation and maintenance of the systems.

F. Minimum thickness for metal ducts shall be per SMACNA guidelines, but in no instance shall be less than 20 gauge for steel ducts and 14 gauge for aluminum ducts.

G. Supports for ducts shall be provided and securely fastened in place at every change in direction and as required to prevent deflection.

H. Changes in size of ducts shall be by means of a taper transformation piece, the included angle of the taper being not more than 20 degrees.

I. All duct work joints shall be sealed to achieve a SMACNA Seal Classification Rating as indicated in the ductwork schedule of this specification.

J. The weight of material used for ducts and stiffeners, the fabrication methods, cross breaking or beading of flat duct surfaces, and assembling of the ductwork shall conform to the SMACNA Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems.

K. All duct panels shall be braced or reinforced as necessary, in addition to the minimum requirements in the ASHRAE Guide, to eliminate vibration and noise and to prevent deflection from the indicted shapes and dimensions.

## 2.02 STAINLESS STEEL AND ALUMINUM DUCT

A. Ductwork material shall be as indicated in the duct schedule in PART 3 of this specification.

B. Stainless Steel: ASTM A480/A480M, Type 316 having a number 2D finish for all applicable ducts and of adequate strength and rigidity to meet the conditions of the service and installation requirements and shall be properly protected where subject to mechanical injury.

C. Aluminum: ASTM B209, alloy 1100, 3003, or 5052 for all applicable ducts and of adequate strength and rigidity to meet the conditions of the service and installation requirements and shall be properly protected where subject to mechanical injury.

D. Transverse duct connections for rectangular ducts shall be bolted, gasketed connections made with standard Ductmate 35 System as manufactured by Duct Mate Industries, W.D.C.I., Elgen, or approved equal. TDC/TDF (T-25) rolled on flanges are acceptable when provided in accordance per SMACNA duct construction guidelines for stiffening and reinforcement. All longitudinal seems shall be Pittsburg Z, or better. Duct flange system material shall match the duct material. Gaskets shall be suitable for exposure to hydrogen sulfide at 2 ppm.

E. Transverse duct connections for round ducts shall be bolted, gasketed connections in accordance with Chapter 12 of SMACNA Round Industrial Duct Construction Standards. Duct connections shall be the same material as the duct. Utilize longitudinal seam ductwork. Gaskets shall be suitable for exposure to hydrogen sulfide at 2 ppm and outdoor use.

F. All ductwork shall be shop fabricated in sections with flanged ends. Where Ductmate 35 flange system is used, it shall be factory spot welded to the ductwork. No field welding of ductwork shall be permitted. Welding equipment and electrodes shall be of a type specifically suited for welding light gauge Type 316 stainless steel or aluminum, as applicable, to provide consistently good quality welds.

G. All duct sections shall be constructed and installed without forming dips and traps.

H. All ducts shall have a minimum clearance of 3 inches from all combustible material.

## 2.03 HANGERS AND SUPPORTS

A. All ductwork shall be securely hung and anchored to the building structure. Unless otherwise shown or specified, hangers and stiffeners for ducts shall conform with the recommendations given in the SMACNA HVAC Duct Construction standards and

SMACNA seismic restraint manual. Ducts shall be supported on trapeze hangers consisting of angles and rods. Use of strap hangers and straps is prohibited.

B. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall be constructed of the same material as the ductwork that it supports with the following exception:

1. Duct supports for Aluminum ductwork shall be Type 316 stainless steel when concrete anchors are required. The Contractor shall provide a full contact 1/8-inch-thick EPDM pad on all sides of the duct that have dissimilar metal contact.

C. All ductwork shall be supported from trapeze type hangers. Stainless steel hanger rods shall be minimum 3/8 inch for all ducts with half perimeter up to 72 inches, and 1/2 inch diameter for all ducts with half perimeter larger than 72 inches. Aluminum hanger rods shall be of sufficient diameter to achieve the equivalent strength of the stainless steel hanger rods for the sizes indicated. A pair of rods shall be provided at each duct support point. Maximum hanger spacing shall be 8 feet for ducts with half perimeter up to 72 inches and 6 feet for ducts with half perimeter larger than 72 inches.

D. Hanger construction and installation shall conform to SMACNA Standards, except as specified. No sheet metal duct hangers or straps will be allowed.

E. Support shall be furnished at each fitting. Material of supports shall match duct material.

F. Hangers, supports, and ductwork shall not have contact with dissimilar metals. Where dissimilar contact cannot be avoided, dissimilar metal contact shall be separated with a full contact 1/8-inch-thick EPDM pad.

G. Seismic & Wind Requirements: All ductwork shall be provided with seismic and wind restraints in accordance with the Seismic Restraint Manual, Guidelines for Mechanical Systems, as published by SMACNA, in accordance with the International Building Code with local amendments, the indicated design wind speed, and ASCE-7 to the extent that the most stringent provisions are utilized. Material of seismic and wind restraints shall be as specified herein. A calculation signed and sealed by a Professional Engineer registered in the state of Georgia shall be provided verifying that the installed supports meet the seismic and wind requirements. See Section 01 73 23 – Anchorage and Bracing of Nonstructural Components, Section 23 05 48 – Vibration and Seismic Controls for HVAC and the Structural Drawings for additional details and requirements.

## 2.04 ACCESSORIES

A. Manual Volume & Backdraft Dampers in Rectangular Stainless Steel or Aluminum Duct

1. Manufacturer: Provide products of one of the following:

a. Greenheck

b. Ruskin

c. Nailor

d. Or equal

2. Frame, blade, axle, bearings, jamb seal, and linkage materials: Match ductwork.

3. Blades

a. Opposed blades for volume dampers and parallel blades for backdraft dampers

b. Vinyl edge seals, thermoplastic elastomer seals for corrosive/chemical services

4. Damper shafts shall be solid hexagonal or square shape.

5. Linkage shall be concealed in damper frame.

6. Provide outside handle, quadrant and approved position indicator and locking device on volume dampers.

7. Reference: SMACNA Standards

B. Stainless Steel Motorized Dampers

1. Manufacturer: Provide products of one of the following:

a. Ruskin

b. Greenheck

c. Or equal

2. Frame, blade, axle, bearings, jamb seal, and linkage materials: Type 316 stainless steel

3. Blades

a. Opposed blades (control) and parallel blades (shut-off)

b. Vinyl edge seals, thermoplastic elastomer seals for corrosive/chemical services

4. Damper shafts shall be solid hexagonal or square shape.

5. Actuators shall be externally mounted to the damper and shall be a minimum of NEMA 2. All actuators shall be enclosed in a NEMA 4X case unless otherwise specified. Actuators located in classified spaces shall be enclosed in a NEMA 7 case unless otherwise specified.

    a. For actuator requirements, see the following:

        1) Section 23 09 01 – HVAC Automatic Temperature Controls (Relay Logic).

6. Damper leakage rate shall not exceed 3 cfm/sq ft at 1 inch w.g.

7. Reference: SMACNA Standards

C. Aluminum Motorized Dampers

1. Manufacturer: Provide products of one of the following:

    a. Ruskin

    b. Greenheck

    c. Or equal

2. Frame, blade, axle, bearings, jamb seal, and linkage materials: 6063T5 Aluminum

3. Blades

    a. Opposed blades (modulating control) and parallel blades (two-position shut-off)

    b. Neoprene blade edge seals and flexible metal compressible jamb seals

4. Damper shafts shall be solid hexagonal or square shape.

5. Actuators shall be externally mounted to the damper and shall be a minimum of NEMA 2. All actuators shall be enclosed in a NEMA 4X case unless otherwise specified. Actuators located in classified spaces shall be enclosed in a NEMA 7 case unless otherwise specified.

6. Reference: SMACNA Standards

D. Duct Mounted Fire Dampers in Fire Walls with Rating of 2 Hours or Less

1. NFPA 90A rated for 1-1/2-hour service

2. Blades, frame, and mounting angles same material as ductwork

3. Accordion style folded blades

4. 165 degrees F fusible link

5. Approved for installation with 2-hour fire rating

6. Rated, manufactured, tested, and approved in accordance with UL 555

7. Blades out of airstream when open (Style B)

8. Furnish with sleeved frame for duct connections.

9. Labeled for use in static mode.

10. Furnish dynamic and horizontal mounted dampers with springs for proper closure.

11. Corrosive Service Dampers: Type 316 stainless steel

12. Manufacturers and Products

    a. Nailor Industries: Model 0130, Type B

    b. Ruskin: (D)IBD20, Type B

E. Duct Mounted Fire Dampers in Walls with 3-Hour or Greater Fire Rating

1. NFPA 90A rated for 3-hour service

2. Blades, frame, and mounting angles

3. Accordion style folding blades

4. 165 degree F fusible link

5. Approved for installation in 4-hour wall

6. Rated, manufactured, tested, and approved in accordance with UL 555

7. Blades out of airstream when open (Type B)

8. Furnish with sleeved frame for duct connection.

9. Labeled for use in static mode.

10. Furnish dynamic and horizontal mounted dampers with springs for proper closure.

11. Corrosive Service Dampers: Type 316 stainless steel

12. Manufacturers and Products

    a. Nailor Industries: Model 0530, Type B.

    b. Ruskin: IBD23, Type B.

F. Combination Louver/Dampers

1. Manufacturer: Provide products of one of the following:

    a. Ruskin

    b. Greenheck

    c. Or Equal

2. Frame, blade, axle, bearings, jamb seal, and linkage materials: 6063T5 Aluminum

3. Inside and outside of all parts shall be coated with a corrosion resistant coating. The coating shall be Kynar 500 or approved equal. Final color selection shall be provided by the Owner. The Contractor shall submit a full color chart for selection and approval.

4. Frame shall be 0.125 inch thick.

5. Front Blades

    a. Drainable with minimum wall thickness of 0.081 inch

    b. Angled at 37 degrees

6. Rear Blades

    a. Double wall airfoil shape with minimum wall thickness of 0.14 inch

    b. Linkage shall be concealed in the frame.

    c. Bearings shall be stainless steel.

    d. Axles shall be stainless steel.

7. Damper shafts shall be solid hexagonal or square shape.

8. Seals

    a. Blade edge seals shall be extruded vinyl.

    b. Jamb seals shall be compressible type of aluminum construction.

9. Drain gutters shall be in head frame and each blade.

10. Downspouts in jambs shall drain water from louver.

11. Provide aluminum bird screens. Screens shall be expanded and flattened type.

G. Stationary Louvers

1. Manufacturer: Provide products of one of the following:

    a. Ruskin

    b. Greenheck

    c. Or equal

2. Frame, blade, and jamb seal materials: 6063T5 Aluminum or Type 316 stainless steel

3. Inside and outside of all aluminum parts shall be coated with a corrosion resistant coating. The coating shall be Kynar 500 or approved equal. Final color selection shall be provided by the Owner. The Contractor shall submit a full color chart for selection and approval.

4. Frame shall be a minimum 0.125 inch thick for aluminum and 18 gauge for stainless steel

5. Blades

    a. Drainable with minimum wall thickness of 0.081 inch for aluminum and 18 gauge for stainless steel

    b. Blades shall be angled at 37 degrees.

6. Drain gutters shall be in head frame and each blade.

7. Downspouts in jambs shall drain water from louver.

8. Provide bird screens in identical material to match louver. Screens shall be expanded and flattened type.

H. Filter Bank

1. Manufacturer: Provide products of one of the following:

    a. Flanders

    b. Or equal

2. Housing and internal rack materials shall match the associated ductwork material.

3. Filter box shall have flanged duct connections.

4. Filters bank shall be V-type arrangement with a minimum of two 2-inch MERV 8 pleated filters.

5. Filter bank shall have a differential pressure switch set to indicate when the filters are dirty. The contacts shall be located in a NEMA 12 rated enclosure in spaces that have unclassified area classifications. In areas that have area classifications, the contacts shall be in a NEMA 7 rated enclosure or the device shall be rated for installation in spaces that are classified as Class I, Division 1 or 2.

I. Sheet Metal Safing: Provide sheet metal safing of the same material as the duct, to close off and seal airtight all unused areas behind louvers.

J. Screens: 1/2-inch (13-mm) mesh, with screen material matched duct material, framed with bolt holes unless indicated otherwise

K. Registers and Grilles

1. Manufacturer: Provide product(s) of one of the following:

   a. Titus (Basis of Design, model numbers scheduled on drawings)

   b. Anemostat

   c. Price Industries

   d. Nailer Industries, Inc.

   e. Hart and Cooley

2. Units shall be factory-fabricated of Type 316 stainless steel construction for stainless steel and FRP ductwork and aluminum for aluminum ductwork. They shall distribute the specified air volume (cubic feet per minute).

3. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance.

4. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers.

5. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling.

6. An additional volume damper shall be installed in duct stub to each air outlet for balancing of air volume.

7. Supply Registers

    a. Supply registers shall be double deflection type, complete with adjustable vertical face bars and a key operated opposed blade damper.

8. Exhaust and Return Registers and Grilles

    a. Exhaust and return registers shall be furnished with fixed vertical face bars, set straight, and a key operated opposed blade damper.

L. Duct-Mounted Access Doors and Panels

1. Provide access doors at all duct connections dampers for access and maintenance of damper motor actuators and linkages.

2. Fabricate doors and panels airtight and suitable for duct pressure class.

3. Seal around frame attachment to duct and door to frame with neoprene.

4. Door and frame to be of same material as duct.

M. Flexible Connectors unless indicated otherwise shall meet the following requirements:

1. Self-extinguishing material shall meet NFPA 90A, NFPA 701 and UL-214 Standards.

2. Material

    a. Commercial grade neoprene coated woven fiberglass, Proflex by DUCTMATE, or approved equal

    b. Corrosion/chemical resistant applications shall be of Teflon coated woven fiberglass fabric. Minimum density 18 oz./sq yd and rated to 500 degrees F.

3. Extra wide edge connectors factory fabricated with a strip of fabric. Material of connectors shall match duct material.

N. Instrument Test Holes: Material to suit duct material, including screw. Size holes to allow insertion of pitot and other testing instruments, and length to suit duct insulation thickness.

O. Turning Vanes

1. Turning vanes shall be double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically.

2. Tab spacing shall be as specified in Figure 2-3 of the 1995 SMACNA Manual – HVAC Duct Construction Standards, Metal & Flexible, Second Edition standard. Rail systems with non-standard tab spacing shall not be accepted.

3. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer's instructions.

P. Drip Pans

1. Drip pans shall be welded 16 gauge, Type 316 stainless steel.

2. Drip pans shall extend 2" beyond the dimensions of the equipment of ductwork above on all sides.

3. Drip pan shall have a minimum 1" lip.

4. Drip pan shall be sloped to a 3/4" copper Type L drain line such that pooling or standing water is prevented. The drain shall be continuously sloped a minimum of 1/8" per foot. The drain shall terminate 6" above the sink or nearest floor drain.

5. Provide a dielectric coupling between the stainless steel drip pan and copper drain line to prevent contact between dissimilar metals.

6. Contractor shall coordinate drip pan supports with the existing structural construction above. The Contractor shall provide all supplemental beams and channels needed. The support system shall be capable of supporting the weight of a full drip pan plus an additional 300-lb. load.

7. See Section 23 05 95 – HVAC Field Testing for drip pan testing procedures.

## 2.05 DUCT INSULATION

A. Insulation shall be provided in accordance with Section 23 07 00 – HVAC Insulation.

# PART 3 – EXECUTION

## 3.01 DELIVERY, STORAGE, AND HANDLING

A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling.

B. Prevent end damage and prevent dirt and moisture from entering ducts and fittings. Where possible, store ductwork inside and protect from weather. If necessary to store outside, store above grade and enclose with waterproof wrapping.

## 3.02 INSTALLATION OF DUCTWORK

A. Examine areas and conditions under which ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Assemble and install ductwork in accordance with recognized industry practices, Manufacturer's installation instructions, and SMACNA standards to achieve the seal and leakage classes indicated in the Duct Construction Table at the end of this specification.

C. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth.

D. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

E. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

F. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment.

G. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 3" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings.

H. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

I. Turning vanes shall be installed in all miter elbows to permit air to make the abrupt turns with a minimum of turbulence. The turning vanes shall be quiet and free from vibration when the system is in operation. Vanes shall be installed in all short radius elbows in accordance with SMACNA Duct Construction standards.

J. The dial regulators for manual volume dampers shall be marked so that the "open" and "shut" positions are clearly identified. The dial regulators on insulated ductwork shall be mounted on an elevated platform which will finish flush with the surface of the insulation. Manual volume dampers shall be located at accessible points and wherever possible

some distance from a duct transition or fitting. Care shall be taken during installation to make certain that sheet metal fasteners do not protrude into the duct and interfere with damper operation. Volume dampers shall be provided in each branch duct take off and in both ducts downstream of each trunk duct split.

K. Duct access doors shall be provided before and after duct mounted coils, within working distance of, and on the fusible link side of all fire dampers, adjacent to volume dampers, on the linkage side of automatic dampers, duct mounted sensors, and at all other apparatus requiring service or inspection in the duct system. Access doors shall be a minimum of 15 x 18 inches; where the size of the duct will not accommodate this size the doors shall be made as large as practical. The doors shall be rigid and airtight, and provided with neoprene gaskets, hinges and sash locks. Whenever space requirements are such that a hinged access door is impractical, a screw fastened lift-out door shall be provided instead.

L. Test openings shall be installed in the ductwork at the points listed below. The test openings shall be a minimum of 3/8" and shall be sealed by a screw cap and gasket, and shall be installed so that the insulation is not disturbed when the cap is removed. The test openings shall be located as follows in all heating, ventilating, air conditioning, and dehumidification systems:

    1. Upstream and downstream of each coil, duct heater, filter bank, or other inline equipment that heats, cools, humidifies, dehumidifies, or filters air.

    2. In the outside air, supply, and return ducts adjacent to the respective connections on all AHUs, HVs, DHUs, etc.

    3. In the main supply duct on single zone units and in each zone supply duct on multizone units

    4. As indicated on the Drawings

M. Air filter gauges for measuring the differential pressure through all filter banks shall be supplied and installed; one gauge shall be installed for each bank. The gauge shall be of the inclined tube differential type complete with 1" thick acrylic plastic body, mirror-polished scale, built-in level vial, over pressure safety traps, signal flags, two vent valves for zeroing gauge, two static pressure tips, two 5-foot lengths of 1/4" stainless steel tubing, two compression fittings, mounting hardware, a bottle of red gauge oil and instructions. The gauges shall have a range of 0 to 1.0 inch water column with minor divisions of 0.02 inch water column.

N. The Contractor shall install prefabricated roof curbs before the installation of roofing.

O. All air outlets shall be with rigid connection to the ductwork.

P. After the installation is completed, the Contractor shall seal all joints air tight. Sealants and tape shall have a flame spread not greater than 25 and a smoke developed rating of not over 50 per ASTM E84.

## 3.03 DUCT LEAKAGE TESTS

A. Where indicated to be required, all openings in the ductwork shall be temporarily sealed and the ductwork shall be pressurized and leak tested to demonstrate that the installation meets the specified SMACNA leakage class requirements. The Contractor shall follow SMACNA procedures for testing as outlined in SMACNA's HVAC Air Duct Leakage Test Manual.

## 3.04 DAMPER AND LOUVER INSTALLATION

A. The Contractor shall install dampers and louvers per the manufacturer's installation instructions.

B. The Contractor shall install all reinforcement required for multi-section dampers and louvers to all the assembly to withstand the rated velocity and pressure of the individual damper and louver sections.

## 3.05 EQUIPMENT CONNECTIONS

A. Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated in the Contract Drawings and Specifications.

## 3.06 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

## 3.07 DUCT SCHEDULE

| Service | Pressure Class | Duct Material | Seal Class | Leakage Class | Construction Standards |
|---|---|---|---|---|---|
| All Areas | +/- 2 inches w.g. | Type 316 stainless steel | A | 12 | SMACNA HVAC Duct Construction Standards |

**END OF SECTION**

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## SECTION 23 34 00
## HVAC FANS

### PART 1 – GENERAL

### 1.01 GENERAL REQUIREMENTS

A. All parts of the equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the unit is to be subjected and shall conform to all applicable sections of these specifications. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these specifications.

B. All anchor bolts, washers, clips, clamps and fasteners of any type shall be constructed of 316 stainless steel.

C. All fan motors shall be provided with high premium energy efficient totally enclosed fan cooled type, unless otherwise noted.

D. Provide exhaust fans which have been tested and rated in accordance with AMCA standard, and bear AMCA Certified Ratings Seal.

E. Provide motors and electrical accessories complying with NEMA standards.

F. Fans shall be standard prefabricated units of the type, size and arrangement indicated on the Drawings. All fans shall be rated and constructed in accordance with the Air Moving and Conditioning Association. Special construction materials, coatings and multi-speed fan motors shall be provided as indicated on the Drawings.

G. Impellers shall be rigidly constructed, accurately balanced dynamically and statically at the speed at which it is scheduled to operate and free from objectionable vibration or noise. Fans with corrosion resistant coatings shall be balanced after being coated.

H. Fans shall have no overloading characteristics for the horsepower indicated. All points on the fan brake horsepower curve shall not exceed the motor horsepower rating

I. Fan shall have a Fan Energy  Index equal to or greater than 1.0 as determined by AMCA 207.

J. V-belt drives shall be rated at least 50 percent greater than the rated motor horsepower, and shall have sheaves which can vary the fan speed by 10 percent above or below the rating point. The fan motor shall be mounted on an adjustable heavy mounting plate.

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K. The operating fan speed shall be no greater than 85% of the maximum allowable fan speed for the selected model.

L. For belt driven fans, airflow rate shall match what is listed in the fan schedule. For direct-drive fans, airflow rate shall be within +10% of the airflow rate listed in the fan schedule.

M. Unless otherwise noted on the Fan Schedule fans shall be manufactured to meet the balance quality and vibration limits of Fan Application Category BV-3 per AMCA Standard 204.

## 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 73 23 – Anchorage and Bracing of Non-Structural Components

B. Section 23 05 48 – Vibration and Seismic Controls for HVAC

C. Section 23 00 00 – Basic HVAC Requirements

D. Section 23 31 13 – Metal Ducts and Duct Accessories

E. Section 23 31 16 – Nonmetal Ducts and Duct Accessories

F. Section 23 05 93 – HVAC Balancing

G. Section 23 05 95 – HVAC Field Testing

## 1.03 SUBMITTALS

A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work required for all equipment specified in this Section in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall submit shop drawings for fan supports, locating and identifying each support, brace, hanger, guide, component and anchor. Fan support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer of the State or Commonwealth in which the project is located and shall comply Section 01 73 23 – Anchorage and Bracing of Non-Structural Components and Section 23 05 48 – Vibration and Seismic Controls for HVAC.

C. Required information shall include:

1. Horsepower, voltage, and rotating speed of motors.

2. Total weight of the equipment plus the approximate weight of the shipped materials.

3. Complete erection, installation, and adjustment instructions and recommendations.

4. Fan performance curve at the operating speed, minimum, and maximum speeds. Provide brake horsepower curve for the operating speed.

5. Details of corrosion resistance coating.

6. Detailed construction information and data sheets for all accessories such as roof curbs, dampers, damper operators disconnect switches, vibration isolators etc.

7. Example equipment nameplate data sheet.

8. Interconnecting wiring diagrams.

9. List of recommended lubricants.

10. Special Tools List

11. Reports of Certified Shop Tests

12. AMCA Approval for Fan Ratings

13. Sound data

14. Manufacturer's Installation Certification

15. Manufacturer's Field Test Results Certification

D. The Contractor shall submit to the Owner a color chart of available colors for the corrosion coating to be applied to fans as indicated in the Contract Documents. The Owner will select the final color choice.

## 1.04 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit complete operation and maintenance manuals in accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures.

## 1.05 MANUFACTURERS

A. The materials covered by these specifications are intended to be equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Contract Drawings and operated per manufacturer's recommendations.

## 1.06 CONTRACTOR'S RESPONSIBILITY AND MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's Technical Representative shall be provided. The manufacturer Technical Representative's services shall include the following site visits:

| Service | Total Days | No. of Trips | Remarks |
|---|---|---|---|
| Installation Checkout | 1 | 1 | In accordance with Section 23 34 00 – HVAC Fans |
| Startup and Testing | 3 | 3 | In accordance with Section 23 05 93 – HVAC Field Testing and Section 23 08 00 – Commissioning of HVAC System |

B. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies noted.

C. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

## 1.07 SPECIAL TOOLS

A. Furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

# PART 2 – PRODUCT

## 2.01 WALL MOUNTED PROPELLER FANS

A. Fans shall be an airfoil propeller fan with integral wall panel. The power assembly shall be bolted to a heavy-duty wall panel with continuously welded corners and an integral venturi. The fan and wall panel shall be all aluminum construction.

B. The propeller shall be extruded aluminum air foil design with cast aluminum hub. The hub shall be keyed and locked to the shaft utilizing two set screws or a taper lock bushing.

C. Propeller shall be balanced in accordance with AMCA Standard 204-05.

D. Provide fans which are listed by UL and have a UL label affixed, and which are designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".

E. Fans shall be V-belt or direct driven as indicated on the drawings or as contained herein.

F. The motor, bearings, and drives shall be mounted on a heavy-duty aluminum power assembly.

G. Fans shall have internal terminal box mounted on the exterior for ready wiring.

H. Adjustable motor plates shall utilize threaded rods to provide positive belt tensioning.

I. Bearings shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L10 life in excess of 50,000 hours at maximum catalogued operating speed.

J. Belts shall be oil and heat resistant, static conducting.

K. Drives shall be keyed and securely attached to the wheel and motor shafts.

L. All drives shall be variable pitched type and shall be sized for 150 percent of the installed motor horsepower.

M. Provide OSHA motor guard to prevent accidental contact with motor or fan blades. The guard shall be of aluminum construction.

N. Provide aluminum wall sleave.

O. Centrifugal fans shall be as manufactured by Hartzell, Greenheck Fan Corp., Loren Cook Co, or Approved Equal.

P. See Paragraph 2.02 of this specification for additional requirements.

**2.02 ADDITIONAL REQUIREMENTS FOR ALL FANS**

A. The following additional requirements shall apply to all fans.

1. Backdraft or motor-operated dampers shall be provided and installed in the openings as indicated on the Contract Drawings.

2. All fans shall be provided with either integral or supplementary spring vibration or sound-absorbing mountings.

3. Where indicated, roof mounted exhaust fans shall be mounted on a prefabricated roof curb.

4. All motors unless indicated otherwise in this Specification or the Contract Drawings shall be TEFC and shall be variable frequency drive rated. The break horsepower at any point on the fan curve for the design speed shall not exceed the motor nameplate horsepower. The break horse power shall include all applicable belt drive losses. Using the motor service factor shall be prohibited. Variable Frequency Drives shall comply with Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers.

5. All equipment shall be seismically secured and restrained in accordance with the Seismic Restraint Manual, Guidelines for Mechanical Systems, latest edition, as

published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) and designed in accordance with the seismic provisions of ASCE-7 and the current Building Code of the State or Commonwealth in which the project is located to the extent that the most stringent provisions are utilized in developing the design seismic forces. See Section 01 73 23 – Anchorage and Bracing of Non-Structural Components and Section 23 05 48 – Vibration and Seismic Controls for HVAC for additional details and requirements.

6. All non-fiberglass fans shall receive a corrosion resistant coating. The coating shall be an epoxy coating suitable for protecting the equipment from continuous exposure to air containing hydrogen sulfide 3ppm. The fans in the Supplemental Carbon Facility shall be suitable for exposure to methanol in addition to hydrogen sulfide. The coating shall be applied to all surfaces of the fans including but not limited to fan wheels, propellers, hubs, structural components, housings (interior and exterior), inlet boxes, dampers, screens, lube lines, curb boxes, and curb box adapters. A UV resistant top coat shall be applied to all coating systems that are not rated for UV exposure. The Contractor shall submit and coordinate the available color choices to the Owner for final color selection.

7. Where indicated in the design documents, fans shall exceed the uncertainty requirements of AMCA standard 203 and shall perform within +/- 3% of the flowrate with respect to the static pressure of the fan curve.

8. Motors with VFDs shall not be selected to operate above the rated motor speed.

## 2.03 DAMPERS

A. See the respective paragraphs in Section 23 31 13 – Metal Ducts and Duct Accessories for construction requirements.

B. Dampers shall be coordinated to operate and interface with the fan being furnished.

C. Dampers shall be sized to fit the specified openings.

## 2.04 PREFABRICATED ROOF AND WALL CURBS

A. Prefabricated roof and wall curbs shall be installed where indicated on the Drawings or as specified herein. The curbs shall be fabricated of .064 inch sheet aluminum with all joints heliarc welded. Cants and roof flanges shall be an integral part of the curb. The inside of the curb shall be insulated with rigid glass-fiber thermal and acoustical liner of approximately 3-lb. density and 1-1/2 inch minimum thickness with a neoprene or equal coating for protection from erosion. The lining shall conform to NFPA 90A Standards with a flame spread and fuel contributed rating not exceeding 50. Pressure-treated wood nailers shall be provided at the tops of the curbs. The curbs shall be sized to suit equipment. Roof curbs shall be a nominal of 12-inches above the height of the roof unless indicated otherwise on the Contract Drawings. The roof curbs shall receive an

epoxy corrosion resistant coating on the interior and exterior surfaces that is suitable for the conditions indicated in the Additional Requirements for All Fans section above.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Contractor shall install fans in accordance with manufacturer's installation instructions and recognized industry practices to ensure that ventilators serve their intended function.

B. Contractor shall coordinate fan work with work of walls, and ceilings, as necessary for proper interfacing.

C. Connect ducts to fans in accordance with manufacturer's installation instructions.

D. The Contractor shall have the Manufacturer’s Technical Representative provide in writing that the equipment is installed per the manufacturer’s requirements and operates as required by the Contract. The Contractor shall submit the written confirmation to the Engineer for information only.

### 3.02 FIELD QUALITY CONTROL

A. Testing: After installation of fans has been completed, test each fan to demonstrate proper operation of units at performance requirements as specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected. See Section 23 05 95 – HVAC Field Testing for testing requirements.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched coatings with a coating specified by the equipment manufacturer for repairs.

**END OF SECTION**

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## SECTION 23 51 00

## BREECHINGS, CHIMNEYS, AND STACKS

### PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This Section specifies flue gas exhaust system and all accessories from the thermal heater outlet to the stack outlet to the atmosphere. Flue gas recirculation (FGR) ductwork (if required by burners furnished) is also specified.

### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of applicable specifications, codes, and standards of the following organizations and entities. Reference Section 01 42 00 – References for full name of organization or entity associated with each of the below acronyms or abbreviations. Unless specifically indicated herein, specifications, codes, and standards by the following organizations and entities refer to the most current issue available at the time of Bid:

1. AISC 325 – Steel Construction Manual
2. ASTM A36 – Standard Specification for Carbon Structural Steel
3. ASTM A242 – Standard Specification for High-Strength Low-Alloy Structural Steel
4. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM A568 – Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
7. AWS D1.1 – Structural Welding Code – Steel
8. MSS SP-58 – Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation
9. NFPA 31 – Standard for the Installation of Oil-Burning Equipment
10. NFPA 54 – National Fuel Gas Code
11. NFPA 211 – Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

12. UL 103 – Standard for Factory-Built Chimneys for Residential Type and Building Heating Appliances

13. UL 441 – Standard for Gas Vents

14. UL 641 – Standard for Type L Low-Temperature Venting Systems

15. UL 1738 – Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV

## 1.3 SUBMITTALS

A. Submittals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and shall include:

1. Manufacturer's Literature and Data including full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

2. Design, materials, weights, construction, pressure and temperature limitations of breeching and stack systems and flue gas recirculation system. Refer to Structural Drawings for seismic design criteria.

3. Drawings showing all components, system arrangement and dimensions.

4. Design, construction, material specifications, allowable movements, movement forces, pressure and temperature limitations of expansion joints.

5. Damper design, construction, pressure and temperature limitations, pressure loss at design flow, and leakage of closed damper.

6. Support designs, locations and loads for entire assembly. Refer to Structural Drawings for seismic design criteria.

7. Written statement from thermal heater/burner manufacturer that the design of the system is satisfactory to achieve the required thermal heater/burner performance.

8. Complete Operating and Maintenance (O&M) manuals in compliance with Section 01 78 23 – Operation and Maintenance Data including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

a. Include complete list indicating all components of the systems.

b. Include complete diagrams of the internal wiring for each item of equipment.

c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

d. All previously submitted documents shall be updated to include submittal review comments, approved substitutions and construction revisions.

9. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion in accordance with the requirements of Section 23 08 00 – Commissioning of HVAC System.

## 1.4 QUALITY ASSURANCE

A. Submit scale drawings showing nominal dimensions and weight of the systems.

B. Thermal heater and burner manufacturer shall review complete system from thermal heater flue gas outlet to stack outlet to atmosphere and advise the Engineer of any changes required to meet thermal heater and burner performance requirements. Note the altitude of Project Site.

C. If a double wall, factory-fabricated, positive pressure breeching and stack system is provided, the manufacturer shall completely engineer the entire system and provide all components. Manufacturer's representative shall provide installation instructions prior to start of construction, train the installers and certify in writing to the Owner that the entire installation complies with the official standards of the manufacturer and with the Contract Documents.

D. Flue gas recirculation ductwork shall be designed and provided by the burner manufacturer.

E. Conform to NFPA 31 and NFPA 54 for sizing, design of flue gas vents, and installation of fuel burning equipment and appliances.

F. Components coming in contact with the products of combustion shall carry the appropriate UL or ULC listing.

## 1.5 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

# PART 2 - PRODUCTS

## 2.1 BREECHING, STACKS, FGR DUCTWORK

A. Acceptable Manufacturers

1. Selkirk – Duravent

2. Industrial Chimney Company

3. Van-Packer

B. Refer to Drawings for arrangement and dimensions, except flue gas recirculation ductwork shall be designed by the burner manufacturer. Flue gas recirculation ductwork construction, material and gauge thickness shall be the same as in the main chimney/stack. Connections to thermal heaters and economizers shall comply with the written recommendations of the thermal heater and economizer manufacturers. Tee sections at 90 degrees are not acceptable; intersections must be made with lateral tees.

C. Service: Design for continuous 1,400 degrees Fahrenheit, 50-inch w.c. positive and negative internal pressure, for a wind loading for outside stacks of 112 mph. Design system and supports for seismic loads in accordance with Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

D. Pre-engineered, Pre-Fabricated, Double-Wall System

1. Complete factory-built system, all components and installation engineered and provided by manufacturer of system.

2. Provide double wall metal stacks, tested to UL 103 and UL 641, and UL-Listed for use with building heating equipment in compliance with NFPA 211.

3. Corrosion-resistant steel, double-wall, circular cross section, positive pressure, blanket insulation between walls.

4. Factory-built standard sections, connected in the field with joining system designed and provided by system manufacturer. Designed to be pressure and vacuum-tight, no deformation, at the service conditions specified.

5. System manufacturer’s engineered support system attached to structural members of the building with expansion joints between rigid supports. Thermal expansion shall be handled by expansion joints and variable spring hangers. Thermal expansion and weight of system shall not impose loads in excess of that allowed by manufacturer of thermal heater, economizer, or any other equipment, or exceed capabilities of building structure. Spring hangers shall conform to MSS SP-58, Type 51, and variable spring.

6. UL-Listed for 4 inches clearance to combustible materials and 1 inch clearance to non-combustible materials.

7. Inner Wall: Type 316 stainless steel, 0.035-inch-thick minimum for diameters 36 inches and smaller and 0.047-inch-thick minimum for diameters greater than 36 inches and through 48 inches.

8. Outer Wall: Aluminized or galvanized steel, except Type 304 stainless steel outside of building, 0.024-inch-thick minimum for inner wall diameter 31.5 inches

and less, 0.035-inch-thick minimum for inner wall diameter greater than 31.5 inches and through 48 inches.

9. Insulation Between Walls: Fiberglass or mineral wool, 1,400 degrees F, minimum thickness 3 inches.

10. Bands for Joining Sections: Same material as section being joined. Utilize sealant provided by system manufacturer.

11. Roof and wall penetrations shall be manufacturer's standard ventilated thimble. Conform to Section 07 60 00 – Flashing and Sheet Metal.

12. Stack Outlet: Provide as shown, double cone rain cap or other type termination designed by manufacturer of the stack system.

13. Drain Section: Provide inside building below roof to drain rainwater from stack. Extend drainpipe to floor drain.

14. Guys: Provide stack guy wires above roof, with spring-loaded tensioners, in accordance with printed instructions of stack manufacturer.

## 2.2 THERMAL HEATER OUTLET DAMPERS AND ACCESSORIES

A. Type: Barometric, single blade, automatically controlled, open-shut operation. Also, modulating operation on systems requiring automatic draft control. Locate at the outlets of the thermal heater.

B. Service: Design for 1,400 degrees Fahrenheit, 5-inch w.g. positive and negative pressure. Maximum leakage, when closed, shall be 10 percent of maximum required flow. Maximum pressure loss at maximum thermal heater steam output shall be 0.04 inch w.c.

C. Construction

1. Blades: ASTM A242 carbon steel, dowelled to shafts

2. Shafts: Stainless steel, provide seals at casing penetrations

3. Bearings: External to flow stream, carbon, self-contained, bushing, packing-gland assemblies, self-lubricating

4. Linkages: Control arms dowelled to shafts, all control arms linked to drive motor, external to flow stream, all steel construction

## 2.3 EXPANSION JOINTS

A. Provide sufficient types, quantities, and locations of expansion joints to completely absorb all thermal expansion of the system without imposing excessive loads on

equipment or building structure. Fabric joints shall be used on single-wall stack and breeching system. On factory-fabricated double wall stack or breeching system, use slip-type, bellows-type, or fabric expansion joints engineered by designer of the stack and breeching system.

B. Service: Design for 572 degrees Fahrenheit, 20-inch w.c. positive and negative internal pressure, continuous duty.

C. Construction, Fabric Joints

1. Fabric: High strength, designed for dewpoint service

2. Internal Baffles: Carbon steel with stiffeners, designed to protect interior surfaces of fabric from wiping action of the flue gases

3. Welded Frame: 1/4-inch-thick, ASTM A568 steel with 4-inch minimum flange height, flat-belt design, fabricated by expansion joint manufacturer. Fabric element bolting, 3/8-inch-diameter, 6-inch maximum centers.

D. Construction, Factory-Fabricated Double-Wall System Joints

1. Materials: Same as factory-fabricated breeching system

2. Packing Gland: High temperature rating, provide seal between sliding and fixed portions of joint

## 2.4 ACCESSORIES

A. Drains: Provide threaded pipe connection to allow drainage at all low points and drain connections in stack and breeching systems. Slope piping system to drain. Pipe size shall be 1 inch minimum.

B. Instrument Ports: Locate on individual stack or breeching serving each thermal heater. Locate in non-turbulent zone within 12 feet of Thermal Fluid Heater Room floor between thermal heater and economizer (when economizer is provided) or locate accessible from platform. Provide separate ports for the following:

1. Flue Gas Oxygen Analyzer: Coordinate with analyzer furnished.

2. Stack Temperature Sensor: Coordinate with sensor furnished.

3. Draft Gauge: 1-inch-diameter coupling, plugged.

4. Test Instruments: 1-inch-diameter coupling, plugged.

C. Access Doors: Bolted, gasketed, insulated, with handles, provide where shown, minimum opening 16 inches x 16 inches.

## 2.5 TYPE B DOUBLE WALL GAS VENTS

A. Fabrication: Inner pipe of sheet aluminum and outer pipe of galvanized sheet steel, tested in compliance with UL 441

# PART 3 - EXECUTION

## 3.1 GENERAL

A. If an installation is unsatisfactory to the Engineer, the Contractor shall correct the installation at no additional cost or time to the Owner.

## 3.2 INSTALLATION – PRE-ENGINEERED, PREFABRICATED DOUBLE WALL SYSTEM

A. Supports: Completely support all systems from the building structure without overloading the building structure or the connected equipment. Support system shall be engineered by the system manufacturer and shall accommodate thermal expansion. Refer to seismic requirements in Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

B. Factory-Fabricated Stack or Breeching System

1. Install in accordance with manufacturer's printed instructions, NFPA 31 and NFPA 54.

2. Submit a copy of the instructions to the Engineer prior to commencing the installation.

3. Representative of manufacturer shall provide field training on all installation techniques to all installers.

C. Connect 1-inch minimum pipes with ball valves to breeching and stack drains. Extend to floor drain.

D. Thermal Heater Outlet Dampers: Locate so that there is no restriction in the flow of flue gas recirculation (if provided).

E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

## 3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Owner.

C. The Commissioning Agent will observe startup and Contractor's testing of selected equipment. Coordinate the startup and contractor testing schedules with Engineer and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

## 3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – Commissioning of HVAC System.

B. Components provided under this Section will be tested as part of a larger system

**END OF SECTION**

## SECTION 23 55 33
## GAS-FIRED UNIT HEATERS

### PART 1 – GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.02 SUMMARY

A. This Section includes gas-fired unit heaters.

### 1.03 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Field Quality-Control Test Reports: From Contractor

C. Operation and Maintenance Data: For gas-fired unit heaters to include in emergency, operation, and maintenance manuals

D. Warranties: Special warranties specified in this Section

### 1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E548

B. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 – Heating, Ventilating, and Air-Conditioning

C. Source Limitations: Obtain gas-fired radiant heaters through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of gas-fired radiant heaters and are based on the specific system indicated.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use

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F. Factory test to check construction, controls, and operation of unit and provide certification. Test operation after installation.

## 1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger of gas-fired radiant heater that fails in materials or workmanship within specified warranty period

B. Warranty Period: 5 years from date of Substantial Completion

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. In other PART 2 articles where following subparagraph titles introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

## 2.02 GAS-FIRED UNIT HEATERS

A. Available Manufacturers

1. Reznor
2. Modine
3. Sterling
4. Trane
5. Approved Equal

B. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8

1. AGA Approval: Designed and certified by and bearing label of American Gas Association
2. Type of Gas: Designed and built to burn natural gas with characteristics same as those of gas available at Project site

C. Performance

1. Minimum Combustion Efficiency: 80 percent

D. Cabinet

1. Construct heater casing and components of 18-gauge (1.21 mm) steel panels, reinforced with angles and channels to ensure rigidity under handling. Provide access panels to burner and blower-motor assemblies. Finish casing and components with heat-resistant baked enamel.

E. Burner

1. The units shall incorporate a single, indirect fired, one piece burner assembly with a single orifice. The burner shall have a continuous wound close pressed stainless steel ribbon separating the flame from the burner interior. All units shall have a single venturi tube and orifice supplying fuel to a one-piece burner housing. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control. Provide gas burner suitable for natural gas. Burner assembly and gas piping arrangement shall include main gas valve, gas regulators, direct spark ignition and manual shut-off valve. Supply gas burner with electrically ignited, supervised pilot. Pilot automatically ignited by spark rod fed by high-voltage ignition transformer.

F. Heat Exchanger

1. The heater shall be equipped with a multi-cell, four-pass serpentine style stainless steel heat exchanger. Heat exchanger tubes shall be press fabricated of Type 316 stainless steel. All heat exchangers shall be fabricated with no welding or brazing, only tool pressed mechanical joints. All heat exchanger cells shall be designed with an aerodynamic cross section to provide maximum airflow.

G. Controls

1. Controls shall include a single-stage gas valve; direct spark multi-try ignition with electronic flame supervision with 100% lockout integrally controlled via a printed circuit control board. The control board shall also incorporate diagnostic lights, DIP switches for blower overrun settings, and a relay (definite purpose 3-pole contactor) for blower only operation. All open (TEFC) blower motors shall have automatic thermal overload protection or be equipped with a factory installed motor starter with adjustable thermal overloads. All units shall be equipped with a safety limit switch. Unit shall have integral thermostat controlling operation, with fan ON/OFF/AUTO switch. Units shall be factory prewired, with single point power connection.

2. All controls shall be enclosed in the sealed control compartment to protect them from accidental damage, dust, and atmospheric corrosion.

H. Fan

1. Provide statically and dynamically balanced fan. Wheel shall be made from aluminum. Provide shaft with heavy duty, self-aligning, pre-lubricated bearings.

I. Combustion Air and Venting

1. The unit shall have a factory-installed power venter device to draw combustion air from outside of the building. The outside air shall enter the unit through a factory-installed round inlet air terminal on the rear of the heater. The control compartment shall be sealed and the access door shall be gasketed to prevent dirt, lint, dust, or other contaminants present in the heated space from entering the unit. The control compartment door shall be equipped with a safety interlock switch to prevent operation when the door is open.

2. The combustion air supply pipe and flue exhaust pipe shall be run in parallel from the heater to a factory supplied concentric adapter assembly, which allows for a single wall or roof penetration, to the (horizontal) (vertical) air inlet and vent terminal.

3. The combustion air/venting system shall include a vibration isolated power venter motor and wheel assembly and a combustion air pressure switch.

## 2.03 TEMPERATURE CONTROL

A. Thermostat: Single-stage, 24VAC, 50° to 90°F operating range and fan On switch

1. Control Transformer: Integrally mounted, 120 to 24VAC

2. Lockable cover

# PART 3 – EXECUTION

## 3.01 EXAMINATION

A. Examine roughing-in for radiant heater piping systems to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.02 INSTALLATION

A. Install heaters level and plumb in accordance with manufacturer’s recommendations.

B. Install and connect gas-fired unit heaters according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.

C. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.

## 3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Gas Piping: Comply with applicable requirements in Section 22 05 00 – Common Results for Plumbing. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service. Provide AGA-approved flexible units.

D. Electrical: Comply with applicable requirements in Division 26.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

E. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

## 3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Test Reports: Prepare a written report to record the following:

a. Test procedures used

b. Test results that comply with requirements

c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements

## 3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

## 3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired radiant heaters.

**END OF SECTION**

# SECTION 23 74 01
# COMMERCIAL AIR HANDLING UNITS
# FOR INDOOR OR OUTDOOR APPLICATIONS

## PART 1 – GENERAL

### 1.01 SUMMARY

A. The entire air handling system(s) shall be provided by one manufacturer with sole responsibility for the satisfactory manufacture, factory testing, installation supervision, and performance of the system(s). Refer to equipment schedule on the Drawings for equipment performance and capacity requirements. The scope of this Section shall include:

1. Air handling units

2. Unit-mounted controllers

3. Unit startup and testing

B. System shall be complete package with air handler. Controls shall be factory mounted and wired. Split system capacities and efficiencies shall be rated in accordance with AHRI 340/360.

C. Wiring and Conduit

1. Wiring and conduit for all single- and three-phase power fed from the electrical distribution system, feeding equipment or field devices, shall be provided under Division 26 – Electrical, installed and terminated by the Electrical Subontractor.

2. Wiring and conduit for controls between HVAC controllers and HVAC field devices, such as thermostats, instruments, or dampers, shall be installed and terminated by the HVAC Subcontractor.

3. Wiring and conduit between HVAC controllers and non-HVAC systems (such as SCADA or FACP) shall be provided under Division 26 – Electrical, installed and terminated by the Electrical Subcontractor. Wire terminations in HVAC controllers shall be by the HVAC Subcontractor, and terminations for non-HVAC systems shall be provided by the Electrical Subcontractor.

4. Wiring and terminations shall meet all requirements of Division 26 – Electrical.

### 1.02 REFERENCES

A. AHRI

B. AMCA

C. ASHRAE

D. NEC

E. NFPA

F. UL

## 1.03 SUBMITTALS

A. The Contractor shall submit shop drawings on all equipment, accessories, appurtenances, and fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Data to be submitted shall include but not be limited to:

1. Catalog data consisting of specifications, illustrations, and a parts schedule that identifies the materials to be used for the various parts and accessories. Identify component materials of construction such as casing and insulation, floor, curb/foundation, access panels, drain pan, filter support racks, dampers, fan housing, and supports.

2. Physical drawings indicating unit dimensions, required operation and maintenance (O&M) clearances, field connection locations, shipping splits, and support/curb drawings

3. Catalog data for all components such as fans, motors, variable frequency drives (VFDs), vibration isolators, coils, dampers and actuators, valves, compressors, filters, airflow measuring stations, airflow switches, filter differential sensors/switches, condensate switches, temperature sensors, humidity sensors, smoke detectors, controllers

4. Coatings, including supplemental coatings as specified

5. Coil heating and cooling performance characteristics. Report coil performance in accordance with the applicable AHRI standard.

6. Supply fan performance characteristics. Report fan performance in accordance with AMCA or AHRI rating system.

7. Sound performance characteristics at unit inlet and outlet connections. Report sound power in accordance with a recognized standard such as AHRI, AMCA, ANSI, or ISO.

8. Losses for each component that induces a static pressure drop

9. Unit casing deflection and leakage performance

10. Electrical characteristics, wiring diagrams, etc.

11. Unitary and system control information including wiring diagrams, input/output modules, thermostats, field devices, and other relevant controls information

12. Piping connection drawings

13. Include all technical deviations and exceptions to the requirements of this Section. The manufacturer shall agree that the equipment is in compliance with all other requirements that are not identified in the list of technical deviations and exceptions.

C. Testing and Startup Documentation

1. Results of all refrigerant testing and charging, including quantity of refrigerant charge

2. Manufacturer's installation checklists after completion

3. Results of functional testing performed by manufacturer's representative

D. The Contractor shall submit O&M Manuals in accordance with the procedures and requirements set forth in the General Conditions, Supplementary Conditions, and Division 01 – General Requirements. O&M Manuals shall be submitted for all equipment.

1. Include instructions for lubrication, filter replacement, and motor replacement; spare parts lists; and wiring diagrams.

2. In addition to a full set of manuals with closeout documentation, each unit shall ship with its own manual in a watertight enclosure.

## 1.04 QUALITY CONTROL

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 5 years of documented experience, who issues complete catalog data on total product

B. All material and equipment shall be the latest design, new, not deteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.

C. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.

D. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.

E. Touch up and/or repaint to match original factory finishes or specially applied corrosion resistant coatings for all finished or painted equipment and materials which are scratched or marred during shipment or installation.

F. Warranty

1. All components, parts, and assemblies shall be guaranteed against defects in materials and workmanship for a period of 1 year. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding startup certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the 30-day operational period after equipment startup. If the equipment does not satisfactorily perform during the 30-day operational period, the start of the warranty period shall be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace, without charge to the Owner, any part of equipment which is defective or showing undue wear within the guarantee period or replace the equipment with new equipment if the mechanical performance is unsatisfactory, including furnishing all parts, materials, labor, etc. necessary to return the equipment to its specified performance level.

## 1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products under the provisions of Division 01 – General Requirements.

B. Accept products on Project Site in factory-fabricated protective containers with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finishes.

D. Protect openings in casings and seal them with plastic wrap to keep dirt and debris out. Protect coils from entry of dirt and debris with pipe caps or plugs.

E. Wrap indoor units with a tight sealing membrane. Wrapping membrane shall cover entire air handling unit during shipping and storage. Cover equipment regardless of size or shape. Alternatively, air handling unit may be tarped for shipment and storage.

F. Wrap equipment, including electrical components, for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust, and corrosion. Keep equipment clean and dry.

G. Tarp outdoor units to protect against rain and road debris during shipping.

H. Clearly mark air handling unit sections with unit tag number, segment sequence number, and direction of airflow. Securely affix safety warning labels.

## PART 2 – PRODUCTS

### 2.01 AIR HANDLING UNITS

A. Provide packaged air handling unit(s) manufactured by one of the following:

1. Trane CSAA (Basis of Design)

2. Daikin

3. Carrier

4. York, Division of JCI (Johnson Controls)

5. Or Approved Equal

B. Unit Casing, Frame, and General Construction

1. Provide a structural base rail under the full perimeter of the unit, formed from mill galvanized steel.

2. Base rail height shall be sufficient to allow proper condensate trapping. Lowest coil condensate drain connection shall not be less than a minimum of 6 inches from the bottom of the rail.

3. Unit Casings

a. The air handling unit casing shall be constructed in a watertight and airtight manner, with 2-inch-thick, double-wall roof panels, floor panels, and wall panels with exterior surface constructed of galvanized steel with an outer finish of enamel or powder coated paint suitable for outdoor installation. The interior lining shall be galvanized steel with an epoxy coating. Wall insulation shall be encapsulated in sheet metal so that air does not contact insulation.

b. The construction of the air handling unit shall consist of a complete structural frame with removable panels. Casing shall be supported in such a manner so that panel deflection does not exceed 0.005 inch or L/240 ratio when subjected to 6-in w.g. static pressure. This maximum leakage shall include the access doors. All panels shall be completely gasketed prior to shipment and shall be completely removable for unit access and removal of

components. Removal of any or all panels shall not affect the structural integrity of the unit.

c. Floor panels shall be double-wall construction, designed to provide a maximum of L/200 deflection based on 300-lb concentrated load at mid-span. The interior liner of the floor panels shall be galvanized steel, aluminum, or stainless steel. Secure an aluminum diamond treadplate liner to floor where personnel entry is required for maintenance or inspections.

d. The manufacturer shall certify that the unit casing deflection does not exceed the previously listed requirements.

e. Casing Integrity

1) No field penetrations through the air handler casing are permitted.

2) Contractor shall coordinate with the manufacturer to allow for all necessary penetrations to provide a complete, functioning, and maintainable system. Internal control devices and sensor shall be shipped to the air handler manufacturer for installation at no added cost to the Owner.

4. Insulation

a. The air handling unit shall be completely insulated throughout all panels and structural frame members with spray-injected foam to thoroughly insulate and seal the air unit structure. Openings in structural channels shall be covered. If structural channels are not internally insulated, then structural channels must be wrapped with a closed-cell foam insulation to maintain unit thermal performance and prevent sweating. Any portion of the unit that is not insulated (gaps) or has less than 2 inches of insulation shall be the responsibility of the Contractor to modify.

1) Insulation shall be a full 2 inches thick throughout the entire unit including all raceway channels. Units with less than 2 inches of insulation in any part of the walls, floor, access doors, raceway channels, or roof are not acceptable

2) Panels shall have a minimum thermal conductivity of R13.

b. Insulation and adhesive shall meet requirements of NFPA 90A. Insulation shall meet the erosion requirements of UL 181.

c. No insulation surfaces shall be exposed to the airstream. Install insulation in a manner to not be disturbed when panels are removed.

C. Access/Inspection Doors

1. Provide steel, double-wall inspection doors of the same thickness and construction as the casing panels. Provide full-perimeter flush-mounted and gasketed doors with a latch and handle assembly.

2. Provide heavy-duty, cadmium-plated steel or stainless steel hinges.

3. Provide minimum 18-inch access doors on fan, cooling, and/or heating coil and filter sections of the unit and additional locations where indicated on the Drawings.

4. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference. Door handle hardware shall visually indicate locking position of door latch external to the module. Door latching hardware shall not penetrate the access doors.

5. All access doors shall open against air pressure unless approved by the Owner in writing.

6. Where scheduled on the Drawings, dual thermal pane windows shall be provided in all access doors. Minimum window dimensions shall be 8 inches x 8 inches.

D. Fans and Related Components

1. Fan Sections

a. Provide fan sections with airfoil (AF), backward inclined (BI), or single-width, single-inlet (SWSI) plug fans (PF), minimum Class II, as scheduled.

b. Higher rpm AF and BI fan casings shall come equipped with additional heavy duty rectangular angle framework for increased strength and stability.

c. Fan and unit performance shall be rated and certified in accordance with AHRI 430, AMCA 300, and AHRI 260 as specified elsewhere herein.

d. Fan wheels shall be constructed of aluminum or steel, keyed to the fan shaft, and statically and dynamically balanced at the factory as a complete fan assembly regardless of duty. Dynamic fan balancing shall be conducted from 16 to 105 Hz to identify and eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Maximum vibration shall be within limits of ANSI/AMCA 204 Fan Application Category BV-4. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

e. Submit factory balancing test report upon request of Engineer.

f. Fan assembly shall be internally isolated to inhibit noise and vibration through air handling unit, ductwork, and building structure. Provide a flexible duct connector between the fan inlet/outlet and unit casing, with materials compliant with NFPA 90A and UL 181 requirements. Fan, motor, and drive assembly shall be internally isolated from air handling unit with spring vibration isolators.

g. Provide differential switch across fan to indicate fan operating status and generate alarm.

2. Motors and Drives

a. Fan motors shall be premium efficiency and compatible for inverter duty and shall meet the endurance and bearing performance requirements for the standard nominal horsepower rating.

b. Fan motors shall have permanently sealed, non-greaseable bearings. Bearings shall comply with ANSI/ABMA 9 for fatigue life ratings and with average life L50 of at least 200,000 hours.

c. For belt-driven fans, mount motor on an adjustable slide rail base. V-belt and cast iron sheave system shall be sized for 150% of the motor nameplate horsepower. All motors with VFDs shall be compatible with the VFD and tested at the factory.

d. Where indicated on the Drawings, furnish VFDs as a part of the unit assembly by the air handling unit manufacturer, with drive matched to motor without noise or vibration over the entire operating range.

E. Heating Sections

1. General

a. Provide coils as scheduled on the Drawings. Provide right- or left-hand horizontal coil connections entry as scheduled or shown on the Drawings. The locations of coil header piping connections shall maximize accessibility while minimizing interference between the coil piping and valves.

b. Construct coil section so coils can be removed without affecting structural integrity of casing. Completely enclose coil headers and return bends within unit enclosure.

c. Coil pull arrangement from the air handling unit casing shall be as shown on the Drawings.

d. Coils shall be rated in accordance with AHRI certified data to meet or exceed the required capacities in accordance with listed parameters, water flow, temperatures and airflow rates as scheduled on the Drawings.

e. Select air velocity and row quantity for cooling coils to prevent moisture carry over.

2. Indirect-Fired Gas Furnace Coil

a. Provide Electrical Testing Laboratories- (ETL-)certified, indirect-fired gas furnace coil where indicated on schedule on Drawings.

b. Furnace coil shall be furnished with all associated accessories for a complete and operational system including:

1) Powered vent blower

2) Category IV flue gas venting

3) Piping manifold with modulating gas control valve and gas shutoff valve

4) Ignition control system with safety features such as flame sensor, flame roll-out switch, high temperature limit switch, airflow switch, high temperature switch, and emergency gas shutoff

c. Tubular design heat exchanger shall be constructed of 409 stainless steel. Construction of heat exchanger shall provide adequate support and flexibility to handle expansion/contraction stresses of heating and cooling cycles.

F. Filter Section

1. Provide disposable, 2-inch- or 4-inch-deep filter section. Filter shall be UL 900-Listed with a minimum rating of MERV 8 unless otherwise specified. Filter modules shall have a maximum width of 24 inches.

2. Air shall not be allowed to bypass around filters. Provisions shall be made to positively lock filters in place to prevent shifting and bypassing.

3. The air handling unit manufacturer shall provide one set of scheduled filters for each air handling unit as shown on the Drawings. The filters shall be boxed and placed within the air handling unit during shipment. The box shall identify the type of filter and shall be labeled with the corresponding air handling unit identification tag number.

4. Where specified, provide additional filter sections for HEPA or gas-phase adsorption media filters.

5. Filter Gauges: Magnehelic differential pressure gauges shall be installed and mounted on drive side of unit to measure pressure drop across the filter sections.

6. Filter Switches: Provide a differential pressure switch to indicate filter status and generate alarm.

G. Electrical Provisions

1. Fan motors shall be factory mounted and wired to an external disconnect switch within sight of the motor access door. Fan motors shall be interlocked with fan access door to shut down fan when door is opened. Follow NEMA standards and publications relevant to applications and use of both metal and liquid-tight flexible conduit.

2. Provide factory-installed marine lights in each section and a GFCI convenience outlet. Lights and receptacles shall be powered by an independent source to allow unit service while power circuit to unit has been locked out.

## 2.02 ELECTRICAL

A. Fan Motors

1. Provide fan motors built in accordance with the latest standards of NEMA and IEEE.

2. Provide air handling unit and fan motors in compliance with ASHRAE 90.1.

3. Provide fan motors with the following characteristics:

a. Voltage, frequency, and phase, as scheduled

b. Motor rpm, as scheduled

c. Minimum service factor of 1.15

d. Premium efficiency or as required to meet ASHRAE 90.1

e. NEMA design ball bearing type

f. Rated for continuous duty at full load in a 104°F (40°C) ambient temperature

g. Totally enclosed, fan cooled (TEFC) as scheduled on Drawings

h. Suitable for use in variable frequency application per NEMA MG-1, Part 30

i. Premium efficiency inverter ready per NEMA MG-1, Part 31.4.4.2

B. Fan Motor Disconnect Switches

1. Provide UL- or ETL-Listed fan motor disconnects and associated components as scheduled and shown on Drawings. Disconnects shall comply with applicable provisions of the NEC.

2. Mount disconnects on the primary access side of the associated fan segment.

a. Mount unit main disconnect (on units with single-point power) on primary access side of supply fan section.

3. Disconnect shall be suitable for use as an OSHA lockout/tagout disconnect when applied in accordance with Part IV of OSHA 29 CFR 1910.147 – The Control of Hazardous Energy (Lockout/Tagout).

4. Disconnect handles shall be lockable in the “off” position with up to three padlocks. Switch mechanism shall be directly lockable in the “off” position via padlock when door is open.

5. Provide disconnects with integral ground lug.

6. Provide auxiliary contacts as scheduled on Drawings.

C. Across-the-Line Fan Motor Starters

1. Provide UL- or ETL-Listed motor starters and associated components as scheduled and shown on Drawings. Starters shall comply with applicable provisions of the NEC.

2. Provide starter in a NEMA 3R enclosure.

3. Mount starter on the primary access side of its associated fan section and wire starter to motor, unless shown otherwise on Drawings.

4. Provide the following features in each starter panel:

a. Main power block

b. Motor contactor(s)

c. Individual starter short circuit and overload protection devices

d. Two primary control fuses and one secondary control line size fuse

e. Three-phase ambient compensated overload heater elements

f. 115V control power transformer with primary and secondary protection

g. Five-point terminal strip for field control connections

h. Factorywired, non-fused, fused main power disconnect, integral with starter panel

i. Integrated on/off auto switch

j. Wiring to fan motor

5. Starters on outdoor units shall be suitable for use in ambient temperatures from 5 to 104°F.

a. Provide low ambient temperature kit suitable for use down to -20°F.

b. Provide high ambient temperature kit suitable for use up to 135°F.

D. Fan Motor VFDs

1. Provide UL- or ETL-Listed VFDs and associated components as scheduled and shown on Drawings. VFDs shall comply with applicable provisions of the NEC.

2. Mount VFDs in a dedicated NEMA 1 compartment located on the primary access side of its associated fan section and wire VFD to motor, unless otherwise indicated on Drawings.

3. Enclose outdoor VFDs in a NEMA 3R enclosure.

4. VFDs on outdoor units shall be suitable for use in ambient temperatures from 5 to 104°F.

a. Provide low ambient temperature kit suitable for use down to -20°F.

b. Provide high ambient temperature kit suitable for use up to 135°F.

5. After unit installation, VFD shall be started and programmed by a factory-trained and employed service technician. Refer to Article 3.02 herein.

6. Provide the following VFD disconnect and bypass option:

a. Non-fused, fused main disconnect

b. Two-contactor VFD bypass with VFD service input switch and non-fused, fused main disconnect

7. Provide harmonic distortion feedback protection:

a. Equivalent 5% impedance input line reactor

b. Integral RFI/EMI filtering to meet EMC EN61800-3 for First Environment

8. Provide a user interface with the following features:

a. 30-Character multi-lingual alphanumeric display

b. Parameter setup and operating data

c. Display data shall include:

1) Output frequency (Hz)

2) Speed (rpm)

3) Motor current

4) Calculated % motor torque

5) Calculated motor power (kW)

6) DC bus voltage

7) Output voltage

8) Heat sink temperature

9) Elapsed time meter (resettable)

10) kWh (resettable)

11) Input/output terminal monitor

12) PID actual value (feedback) and error

13) Fault text

14) Warning text

15) Scalable process variable display

9. Provide VFD with the following protection circuits:

a. Overcurrent

b. Ground fault

c. Overvoltage

d. Undervoltage

e. Over temperature

f. Input power loss of phase

g. Loss of reference/feedback

h. Adjustable current limit regulator

10. VFD shall be UL 508C approved for electronic motor overload (12t).

11. Provide high input transient protection and surge suppression.

12. Provide the following communication features:

a. Two programmable analog inputs

b. Six programmable digital inputs

c. Two programmable analog outputs

d. Three programmable digital relay outputs

e. Modbus RTU communications protocol

f. Adjustable filters on analog inputs and outputs

g. Input speed signals, including 4-20mA and 0-10VDC

h. Accel/Decel contacts (floating point control)

i. Auto restart (customer selectable and adjustable)

j. Start/Stop options shall include 2-wire (dry contact closure), 3-wire (momentary contacts), application of input power, and application of reference signal (PID sleep/wake-up)

k. Integrated serial communication compatible with Building Management System (BMS) utilized by Automatic Temperature Controls (ATC) Supplier.

## 2.03 FACTORY-ENGINEERED AUTOMATIC TEMPERATURE CONTROLS

A. Controls shall be factory supplied, wired to the manufacturer's standard system controller(s), and tested to facilitate field commissioning of the unit. Field-mounted

components, such as thermostats and duct detectors, shall be shipped loose for field installation with designated terminals in the unit's controller or a factory-installed terminal board.

B. Units provided with a factory-wired, -installed, and -tested unit controller(s) shall be capable of standalone unit operation or tied into a BMS through Bacnet communication. All factory mounted control points in unit shall be tested prior to shipment.

C. Unitary controls shall be coordinated with ATC supplied to ensure compatibility and provide all functionality and signals as specified, capable of controlling all unitary or system functions including, but not limited to:

    1. Supply fan start/stop and speed control

    2. Outdoor air and/or return air damper modulation

    3. Gas furnace capacity modulation and safety controls

D. Unitary controllers shall be furnished with terminal boards as necessary to send/receive signals from BMS, factory-installed components, and/or field-installed components. Where unitary controller is not capable of handling specified signals, the ATC system shall include terminal boards suitable for sending/receiving signals. Signals shall include, but not be limited to:

    1. Discharge air and outdoor air temperatures

    2. Discharge air flowrates

    3. Filter differential pressure

    4. Fan differential pressure

    5. Duct static pressure for fan speed modulation

    6. High duct static pressure for fan shutdown

    7. Fan start/stop commands, speed control commands, speed feedback, and operating status feedback

    8. Modulating damper command and position feedback

E. Refer to control sequence and Drawings for additional information, including interlocked or other system components such as zone thermostats, occupancy sensors, etc.

F. Additional Considerations

    1. All factory wiring shall be internal to the unit to minimize casing leakage.

2. All wiring at unit splits shall be connected with quick-connects; no field splicing of wiring is allowed.

3. Control panels shall be factory mounted, and all end devices shall be terminated either directly to the controller or to a terminal block.

4. Control panels shall include integral 24VAC transformers with circuit breaker overloads.

5. No low-voltage controls or communication wiring shall be run in the same tray, conduit, or proximity as any medium- or high-voltage wiring.

6. Mount averaging temperature sensors to cover as much cross-sectional area of the interior unit as possible. Provide end and support brackets to support sensing element and eliminate strain.

7. When mounting probe temperature sensing elements at discharge and air inlet openings, use support brackets to provide a solid mounting location to minimize vibration effects.

8. Mount all actuators for control dampers within the frame of the damper. Actuators shall be mounted on the access side of the damper to facilitate commissioning and servicing.

9. Mount low temperature cut out sensors on downstream face of first water coil within the coil housing frame.

10. Mount high temperature cut out sensors so that the manual reset switch is accessible from the fan section access door. The temperature sensor shall be mounted in the discharge air stream.

11. High- and low-pressure cutout devices shall be mounted so that the manual reset switch is accessible from the fan section access door without putting operator at risk.

12. The differential pressure switch for filters shall have pressure pick up points located on either side of the filter section.

13. Factory-mounted control panels shall be mounted to the exterior wall of the supply fan section. Internal unit wiring shall be brought into the panel through a single rear knockout. The penetration shall be sealed to prevent air and moisture leakage. Unless single-point power option is selected, power to the control panel requires a field-supplied connection.

14. Factory-packaged controls shall be factory tested using a functional test method. All inputs (AI, BI, DI) and outputs (AO, BO, DO) shall be tested. All sensors and

switches shall be cycled through a change of state. All actuators shall be stroked to verify correct operation and rotation through the full operating range. The factory test data results shall be fully documented including all operational conditions. A factory test report document shall be available for each unit. The factory test report shall be provided to the Commissioning Agent.

## 2.04 APPURTENANCES

A. Provide rain hoods on outdoor unit air intakes as shown on Drawings. Provide moisture screens on outdoor air inlet rain hoods.

B. Provide steel (structural formed or welded) base rails suitable for rigging and lifting as shown on product drawings.

C. Provide safety grates over bottom openings as shown on Drawings.

1. Safety grates shall be capable of supporting a 300-lb center load.

D. Provide lifting lugs where required.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and shall conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install in conformance with AHRI standards.

D. Make joints and connections fully gasketed and airtight.

E. Contractor shall furnish and maintain and replace clean pre-filter media in each air handling unit as listed in the equipment schedule on the Drawings during startup and construction. The Contractor shall install the tagged set of new filter products provided by the air handling unit manufacturer for each unit after it has been tested and commissioned and receives final acceptance by the Owner.

F. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated, and fan has been tested and run under Owner representatives’ observation.

G. Equipment Cleaning

1. Clean dirt and marks and other debris from exterior of equipment.

2. Remove debris and waste material resulting from installation.

## 3.02 MANUFACTURER'S SERVICES

A. Furnish services of qualified manufacturer's factory-trained service personnel to assist in the installation of the equipment, check the installation before it is placed into operation, and supervise initial operations.

B. Pre-Startup Inspections and Equipment Startup

1. All pre-startup checklists shall be completed and submitted to Engineer.

2. Results of manufacturer's standard startup procedures shall be submitted to Engineer. Startup shall demonstrate system's ability to perform all operating sequences and modes of operation.

**END OF SECTION**

## SECTION 23 74 05
## POSITIVE PRESSURIZATION UNITS

### PART 1 – GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Supplementary Conditions and Division 01 – General Requirements, apply to this Section.

### 1.02 SUMMARY

A. The Contractor shall furnish all labor, equipment and material for the complete installation of the positive pressurization air scrubbing units (PPUs) as indicated on the Drawings and specified herein.

B. Work Included Under Other Sections

1. 480V, 3-phase power wiring and conduit under Division 26 – Electrical

2. 120V, 1-phase wiring and conduit to motorized dampers under Division 23 meeting the requirements of Division 26 – Electrical

### 1.03 SUBMITTALS

A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Data to be submitted shall include but not be limited to:

1. Catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.

2. Include all specification technical exceptions in the submittal. The manufacturer agrees that the equipment is in compliance with Specification Sections that are not identified in the list of technical exceptions.

3. Complete assembly and installation drawings with clearly marked dimensions. This information shall be in sufficient detail to serve as a guide for assembly and disassembly and for ordering parts.

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4. Weight of scrubbing media and unit assembled weight.

5. Electrical characteristics, wiring, diagrams, etc.

6. Sample data sheet of equipment nameplate(s) including information contained thereon.

## 1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under the provisions of Division 01 – General Requirements.

## 1.05 SPARE PARTS

A. Provide a minimum of two sets of spare pre-filters, two sets of final filters, two sets of chemical media modules as applicable.

## 1.06 MANUFACTURER'S INSTRUCTIONS

A. Installation of all equipment shall be in accordance with manufacturer's data.

B. All changes from the installation procedures in manufacturers' data shall be submitted for approval in accordance with the requirements for shop drawings.

C. Keep all manufacturers' data provided in a secure manner at the job site at all times. Catalog and index this data for convenient reference.

D. Manufacturers' data shall be available for the information of the Owner, Engineer, and the use of other trades.

E. Turn over all data to the Owner through the Owner's representative at completion of the Work and final testing.

F. Submit all instruction books and manuals in accordance with Division 01 – General Requirements.

## 1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 5 years of documented experience, who issues complete catalog data on total product.

B. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.

C. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.

D. Touch up and/or repaint to match original factory finishes for all finished or painted equipment and materials which are scratched or marred during shipment or installation.

## PART 2 – PRODUCTS

### 2.01 POSITIVE PRESSURIZATION CARBON FILTERING UNIT

A. Subject to compliance with requirements, provide PPU(s) manufactured by one of the following:

1. Purafil

2. American Air Filter

3. Or approved equal

B. The modular chemical scrubber shall be a complete package designed for the removal of both organic and inorganic contaminants from the re-circulated air in gas or vapor atmospheres. The manufacturer shall have a minimum of 10 years of experience in the design, fabrication and testing of systems that are 99.95% efficient in the removal of these gases. The manufacturer shall be a single source provider of equipment, media and testing services, and be certified to ISO-9001 standards or adhere to quality standards equal to ISO-9001. Controls shall be factory mounted and wired.

C. Scrubber Housing Construction

1. The scrubber housing shall be constructed of 14-gauge cold rolled steel, seam welded. The unit shall be provided with gasketed front access door(s) for servicing all components. Latches shall have a positive locking action. All hinges and draw latches shall be constructed of stainless steel. The scrubber shall be designed for indoor installation.

2. Welding procedure qualifications and welder performance qualifications shall conform to the requirements of Section IX of the ASME Code, latest edition. Welder’s performance qualification records shall be made available to Engineer upon request.

3. Housing shall be painted inside and out (before assembly) using the following three-step procedure:

a. Step 1: Steam/pressure wash with a paint prep (Oakit 187SC, or approved equal)

b. Step 2: Epoxy prime (CheckRust Insl-Tile Activated Epoxy Coating, EP-5000 Series, or approved equal)

c. Step 3: Polyurethane final coat of no less than 1.5 mils (CheckRust Insl-Thane Heavy Duty Polyurethane Enamel, GU-2500 Series or approved equal). Color shall be gray.

4. Scrubber housing shall be provided with a base support.

5. The scrubber housing shall be designed to facilitate standard fan and motor for maintenance.

6. Door seals shall be attached by mechanical means and designed for replacement. Seals shall be glued in conjunction with mechanical attachment.

7. The scrubber shall be arranged for horizontal or vertical airflow and shall deliver the designated combined airflow (pressurization plus recirculation). There shall be a manually controlled damper located at the intake for optimization of pressurization air.

8. Aluminum nameplate shall be provided, permanently attached to the unit. Nameplate shall be engraved with the scrubber type, order number and serial number.

9. Inlet pressurization air shall be ducted by the Contractor into the duct opening at top of unit. The re-circulation air shall enter in from an air intake grill located above the pre-filter. The return and discharge openings shall include grilles with four-way deflection louvers.

10. If the named Purafil PPU is provided, the Purafil PPU-1000V shall contain four sections of scrubbing. The first stage shall contain two particulate pre-filters, Model Purafil TP-25 and sized 24” x 24” x 1”. The second stage shall contain six PuraGrid Filters with Puracarb and shall measure 24” x 24” x 4”. The third stage shall contain modules consisting of four 24” x 12” x 12” PK-12 polystyrene containers filled with Purafil SP Blend. The fourth stage shall contain two particulate final filter model Purafil JFL-90 and shall measure 24” x 24” x 5”.

D. Blower shall be located in the housing between the second and third stages of air cleaning. It shall have a backward curved, centrifugal, glass reinforced polyamine wheel and direct variable frequency drive. The blower drive system shall include provisions to readily adjust belt tension. The blower system rating shall be as specified on the Drawings. Sound insulation shall be provided on the blower section for decibel reduction.

E. Motors shall be TEFC premium efficiency, inverter grade, 460V, 3-phase, 60 Hz and shall have a 1.15 service factor.

F. Scrubber Chemical Media Sections:

1. The housing shall contain two chemical media sections, designed to accommodate 12” modular media containment devices utilizing filter rack tracks.

2. Modular media containment device (module) shall have a nominal size of 24” wide x 12” high x 12” deep in direction of airflow with a medium bed depth of 3”. Device shall be completely recyclable and/or disposable. Device shall be constructed of 0.125” thick, black, high impact polystyrene.

3. Module shall be factory-filled with selected chemical media.

4. Pressure drop through each chemical media section shall not exceed 1.30” water gauge. Maximum airflow velocity through the chemical section shall be 250 feet per minute.

5. The residence time through the chemical media section shall not be less than 0.24 seconds total, of 0.12 seconds per media bed in direction of airflow. Residence time calculations shall only include media in direct path of air.

6. Module shall be UL Class II. Manufacturer shall provide documentation.

7. Media shall be specifically for corrosive environments and consist of spherical, porous pellets composed of carbon, alumina and other binders impregnated for reaction for removal of hydrogen sulfide, sulfur dioxide, and volatile organic compounds.

8. If the named Purafil PPU is provided, the Purafil SP Blend Media shall consist of an equal mix (by volume) of Purafil SP Media and Purakol media. Purafil SP Media shall be manufactured of generally spherical, porous pellets formed from a combination of powdered activated alumina and other binders, suitably impregnated with sodium permanganate to provide optimum adsorption, absorption, and oxidation of a wide variety of gaseous contaminants. The sodium permanganate shall be applied during pellet formation, such as the impregnate is uniformly distributed throughout the pellet volume and is totally available for reaction. Purakol Media shall be a premium grade, activated carbon with a high surface area available for adsorption.

9. Media Removal Capacity: Hydrogen Sulfide 20% minimum by weight, Sulfur Dioxide 5% minimum by weight, Chlorine 8% minimum by weight

10. Media Application Criteria: Temperature -4 to 125°F, relative humidity 10 to 95%

G. Particulate Filters

1. Pre-filters shall be 30% efficient disposable filters. Efficiency shall be rated and tested to ASHRAE Standard 52-76, Dust Spot Efficiency. The clean filter resistance shall not exceed 0.20” of water gauge based on a face velocity of 100 feet per minute. Filters shall be 1” deep Purafil PP-30 or equivalent by other manufacturer.

2. Final filters shall be 85 to 90% efficient pleated disposable filters. Efficiency shall be rated and tested to ASHRAE Standard 52-76, Dust Spot Efficiency. The clean filter resistance shall not exceed 0.30” of water gauge based on a face velocity of 100 feet per minute. Filters shall be Purafil JFL-90.

H. Remote and Unit Factory-Mounted Control Panels (refer to Drawings for mounting type)

1. NEMA 1, 18-gauge galvanized steel, riveted fastening, powder-coated enclosure. Doors shall be louver vented to allow even air flow from the front to the back of the cabinet. The doors shall be constructed of 20-gauge galvanized steel and powder coated. Doors shall be equipped with 1/4-turn keyed latches. Enclosure shall be shipped loose for wall mounting in the field or factory mounted on side of unit as indicated on Drawings.

2. NEMA 4X, Type 316 stainless steel enclosure with stainless steel hardware. Door shall be gasketed and shall have screw latches for sealing. Enclosure shall be shipped loose for wall mounting in the field or factory mounted on side of unit as indicated on drawings.

3. Motor VFD: Sized accurately for motor sizes as indicated or scheduled on Drawings

4. Control power transformer, 460/120 VAC, with fused primary and secondary

5. Main circuit breakers, magnetic, with front-panel operating handle disconnect

6. “Hand-Off-Auto” selector switch

7. Indicating Lamps (all lamps shall be push-to-test style): FAN OFF and FAN RUNNING

8. Complete air measuring station and room pressurization gauge

I. Required Factory Options

1. Room pressurization and airflow gauge (mounted on control panel face as previously described herein)

2. Static pressure differential gauges, pre-filter and final filter

3. Onguard 4000 for real-time airborne molecular contaminant (AMC) monitoring

a. Service life of 4000 Angstroms shall be provided.

b. The OG4 shall come with two quartz crystal microbalance (QCM) sensors, one plated with copper and one plated with silver

c. Battery-operated via four standard AA batteries and one lithium battery to be supplied by Contractor. The Onguard 3000 shall also be powered by an external DC power supply or a PC USB port.

d. LCD display

e. 4-20mA output signal with corresponding installation instructions or internal data logger

f. Onguard shall have two QCM sensors, one plated with copper and one plated with silver, which accumulation corrosion films when acid gases react with the base metal. System shall be placed by Contractor near the unit.

g. Device shall use Simple Network Management Protocol (SNMP) and shall be accessible to a web browser.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state/commonwealth and local requirements and referenced standards and shall conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install units on vibration isolators where fans are not internally isolated.

D. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation of the Engineer.

E. Provide the minimum access space for maintenance of individual components such as fans, filters, coils, humidifiers, etc., as scheduled or shown on the Drawings. Arrange these components in a manner that allows for ease of replacement.

F. Arrange fans and surrounding components in such a way that poor fan performance does not result.

G. Remote wall mounted control panels shall be installed per NEC clearance requirements.

### 3.02 GUARANTEE

A. All components, parts, and assemblies shall be guaranteed against defects in materials and workmanship for a period of 1 year. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding startup certification provided by the manufacturer's technical representative as specified herein,

provided that the equipment demonstrates satisfactory performance during the 30-day operational period after the equipment startup. If the equipment does not perform satisfactorily during the 30-day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period or replace the equipment with new equipment if the mechanical performance is unsatisfactory, furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.

## 3.03 STARTUP SERVICES AND MEDIA TESTING

A. The manufacturer shall be able to provide in-house lab analysis of the equipment media predicting the remaining life cycle of the media. Such service shall be provided at the manufacturer’s expense. Such service shall be provided at the manufacturer's expense for a period of at least 10 years.

**END OF SECTION**

## SECTION 23 81 26
## SPLIT-SYSTEM AIR CONDITIONERS

### PART 1 – GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.02 SUMMARY

A. The Contractor shall furnish all labor, equipment and material for the complete installation of the air conditioning (heat pump) system as indicated on the Drawings and specified herein.

B. Heating, Ventilating and Air Conditioning systems shall be furnished and installed to operate as a system. The Contractor shall coordinate all requirements between manufacturers to ensure unit responsibility and compatibility of the systems.

C. Work Included Under Other Sections

1. 480V, 3-phase power wiring and conduit under Division 26 – Electrical.

### 1.03 SUBMITTALS

A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Data to be submitted shall include but not be limited to:

1. Catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories.

2. Electrical characteristics, wiring, diagrams, etc.

3. Piping connection drawings.

4. Include all specification technical exceptions in the submittal. The manufacturer agrees that the equipment is in compliance with Specification Sections that are not identified in the list of technical exceptions.

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C. The Contractor shall submit operation and maintenance manual in accordance with the procedures and requirements set forth in the General Conditions and Division 01. Operation and Maintenance Manuals shall be submitted for all equipment.

1. Include instructions for lubrication, filter replacement, motor replacement, spare parts lists and wiring diagrams.

2. In addition to a full set of manuals with closeout documentation, each unit shall ship with its own manual in a watertight enclosure.

## 1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under the provisions of Division 01.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.

C. Protect openings in casing and seal them with plastic wrap to keep dirt and debris. Protect coils from entry of dirt and debris with pipe caps or plugs.

## 1.05 EXTRA MATERIALS

A. Provide one additional set of filters for each unit, packaged for storage. Tag products to identify associated unit.

## 1.06 SCHEDULES ON DRAWINGS

A. In general, all capacities of equipment and motor and starter characteristics are shown in schedules on the Drawings. Reference shall be made to the schedules for such information. The capacities shown are minimum capacities. Variations in capacities of the scheduled equipment supplied under this Contract will be permitted only with the written direction of the Engineer.

B. Motors sizes shown on the schedules are the minimum. If a larger motor horsepower is required, it shall be so quoted and noted.

## 1.07 INDUSTRY STANDARDS

A. All equipment, materials and installations shall conform to the requirements of the most recent edition with latest revisions, supplements and amendments of the following, as applicable:

1. ARI

2. AMCA

3. ASHRAE

4. NEC

5. NFPA 90A – Air Conditioning and Ventilation Systems 2009 edition

6. State/Commonwealth and local codes, ordinances and statutes

7. UL

8. Others as designated in the Specifications.

## 1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 5 years of documented experience, who issues complete catalog data on total product.

B. All material and equipment shall be the latest design, new, not deteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.

C. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.

D. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.

E. Touch up and/or repaint to match original factory finishes or specially applied corrosion resistant coatings for all finished or painted equipment and materials which are scratched or marred during shipment or installation.

# PART 2 – PRODUCTS

## 2.01 AIR CONDITIONING UNITS

A. Provide air conditioning unit(s) manufactured by one of the following:

1. Trane (Basis of Design)

2. Carrier

3. York, Division of JCI (Johnson Controls)

4. Or Approved Equal

B. Air conditioning units shall be complete package with air handler matched with air cooled condensing unit. Controls shall be factory mounted and wired.

C. Air Cooled Condensing Unit (Heat Pump)

1. General: Units shall include hermetic scroll compressors, plate fin condenser coils, fans and motors, controls and holding charge of nitrogen. Operating range shall be between 115°F and 0°F in cooling.

2. Casing: Unit casing shall be constructed of zinc coated galvanized steel. Casing surfaces shall be finished with HERESITE VRL-506 (gray) air dry phenolic coating system. Units shall have removable panels which allow access to all major components and controls.

3. Refrigerant System: The air handling unit shall have a single refrigeration circuit. All refrigerant circuits shall be controlled by a factory-installed thermal expansion valve.

4. Compressors: Crankcase heater, internal temperature and current-sensitive motor overloads shall be included for maximum protection. Scroll compressor shall provide inherently low vibration and noise by having no suction and discharge valves. External high and low pressure cutout devices shall be provided. Evaporator-defrost control provided in indoor blower coil shall prevent compressor operation when low evaporator coil temperatures are encountered.

5. Condenser Coil: Coils shall be internally enhanced 3/8-inch copper tubes mechanically bonded to configured aluminum plate fins. Coils shall be factory pressure and leak tested. Coils shall be coated with HERESITE P413-C baked phenolic coating system. Provide condenser coil guard grille.

6. Condenser Fan and Motor(s): Direct-drive, statically and dynamically balanced propeller fan(s) shall be used in draw-through vertical discharge position. Fans shall be aluminum construction and coated with heresite VRL-506 (gray) air dry phenolic system. Either permanently lubricated totally enclosed or open construction motors shall be provided and shall have built in current and thermal overload protection. Motor(s) shall be either ball or sleeve bearing type.

7. Controls: Condensing units shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall have single point power entry.

8. Low Ambient Operation: Head pressure control shall be provided to permit operation to 0°F outdoor ambient temperature.

D. Blower Coil Air Handling Unit

1. Blower coil units shall be completely factory assembled including coil, condensate drain pan, fan motor, filters and controls in an insulated casing that can be applied in either vertical or horizontal configuration. Units shall be rated and tested in

accordance with ARI Standard 210/240, 340/360. Units shall be UL listed and labeled.

2. Casing: Unit shall be constructed of sheet metal and steel frame with removable front or side panels. Removal of panels must not affect the structural integrity of unit. All exterior wall panels shall be made of minimum 20-gauge baked enamel finished (Heresite VR-508 coating on both sides of unit casing) steel. Casing shall be insulated with knockouts provided for electrical power, control wiring and piping connections.

3. Evaporator Coil: Configured aluminum fin surface shall be mechanically bonded to 3/8-inch OD copper tubing. Coils shall be factory pressure and leak tested. Coils shall be coated with HERESITE P413-C baked phenolic coating system.

4. Evaporator Fan: Forward curved (FC), centrifugal-type fan(s) with multi-speed direct drive. All fans statically and dynamically balanced and tested after being installed on properly sized hollow or solid shafts. Fan shafts shall not pass through their first critical speed as unit comes up to rated rpm. Fan wheels shall be coated with HERESITE VR-508 air dry phenolic coating system. Thermal overload protection shall be provided for the motor. Fan and motor bearings shall be permanently lubricated. Oversized motors shall be available as an option for high static application. All motors shall meet the US Energy Policy Act of 1992 (EPACT).

5. Controls: Magnetic evaporator fan contactor, low-voltage terminal strip, check valve(s), single point power entry and plug in module for accessory electric heat control shall be included. All necessary controls shall be factory installed and wired. Evaporator defrost control shall be included to prevent compressor slugging by temporarily interrupting compressor operation when low evaporator coil temperatures are encountered. A space zone sensor shall be provided by unit manufacturer.

6. Electric Heater (If Scheduled on Drawings): The electric coil along with the complete air handling unit shall be listed as an entire assembly by UL with the appropriate UL labels. Electric coils in galvanized steel frames shall have open resistance type heating elements of 80 percent nickel and 20 percent chromium. Elements uniformly distributed over cross-sectional area of unit with vertical support brackets to prevent coil element sag. Coil elements insulated from metal by ceramic bushings. Maximum element heating density for preheat coils of 55 watts/inch$^2$ and hot deck coils of 35 watts/inch2. Expanded steel baffle provided on coil inlet for uniform airflow and protection of service personnel. Electric coils rated for 460/60/3 operation with equal, balanced, three-phase stages. Electric coils provided with built-in primary automatic and secondary manual reset thermal protection devices, and static pressure type airflow switch that prevents energizing when airflow is inadequate.

7. Filters: Filters shall be accessible from either side coil access panel. Filter rack shall have low-velocity, 2-inch pleated cotton or synthetic fiber, Merv 8 or 9, throw-away filters.

## 2.02 REFRIGERANT PIPING

A. Products and Manufacturers

1. Refrigerant Piping Specialties

a. Sporlan

2. Expansion Valves

a. Sporlan

b. Alcoa

3. Silver Solder: "Easy-Flow 45"

a. Harman

4. Moisture Indicator: "SEE-ALL"

a. Sporlan

B. Refrigerant Piping

1. Copper tubing conforming to ASTM B280 and/or FS WW-T-799, dehydrated for refrigerant use, with high-temperature soldered joints and wrought copper (400 psig) fittings.

a. For underground use: Type K

b. For aboveground use: Type L

C. Piping Joints

1. Joints between copper tubing and fittings to be high temperature brazed joint (melting point not less than 1000°F, Harris Products Stay-Silv 15. Do not use flux. Purge the line with nitrogen to prevent scale build up.

2. Joints between copper and brass, steel, etc., shall be silver soldered only, Harris Products Safety-Silv 45 with Stay-Silv White Brazing Flux.

D. Pre-Charged Line Sets: Size per manufacturer's recommendations.

E. Field-Assembled Units

1. Size refrigeration lines according to manufacturer's published tables using pressure or temperature drops as follows:

a. Suction Lines: 2 degrees F

b. Liquid Lines: 1 degree F or 2 psi

c. Hot Gas Lines: 1 degree F or 3.6 psi

d. Size discharge and hot gas risers for positive oil return to compressors.

F. Refrigerant Dryer

1. Sporlan material "CATCH-ALL" filter-drier with aluminum molded core

2. In each liquid line

3. A three-valve bypass around filter-drier

4. Install so core can be removed without cutting or breaking any refrigerant line.

G. Moisture Indicator

1. Show presence of moisture in system by change of color.

2. Install full size in the main liquid line adjacent to the filter-drier.

3. Use Sporlan "SEE-ALL".

H. Strainers

1. Design to permit removing screen without removing strainer from piping system.

2. Screens not larger than 80 mesh.

3. Strainers on liquid line serving each thermostatic expansion valve and in suction line serving each refrigerant compressor not equipped with integral strainer.

I. Oil Traps: Provide in lines as required.

J. All Valves

1. All bronze

2. 2-inch and Smaller: Solder ends

3. 3-inch and Larger: Four-bolt union ends

K. Shut-Off Valves

1. Packed type with gas-tight cap seal and hard metal seats and shoulders which permit packing stuffing boxes wide open under pressure; or sealed diaphragm type

2. Wheel, globe, angle or "T" handle

L. Check Valves

1. In Liquid Lines 5/8-inch and Less: Lift check type

2. In Lines 3/4- to 2-Inch: Swing check type

3. In Lines 3-Inch and Larger: Wafer type swing check with bronze disc

M. Expansion Valves

1. Sized by manufacturer for refrigerant used

2. Provide one in each circuit with liquid distributor connection immediately after.

N. Vent and Test Valves: Angle cap type with seal and outlet caps.

O. Pre-Charged Line Sets: Install per manufacturer's recommendations.

P. Field Assembled Lines

1. Refrigerant Piping

a. Purge refrigerant piping of all air while connections of refrigerant piping are being made.

1) Shut-off valves.

2) Connect tank of dry nitrogen to line on back side of valve.

3) Introduce dry nitrogen into line as refrigerant piping joints are successively made up from valve to each condenser.

2. Testing

a. Refrigerant Piping Systems: Follow general testing guidelines of ASHRAE 15, except as modified herein.

b. Pressurize the high and low pressure sides of the piping system after completion of the refrigerant piping.

c. Pressurize at the test pressures specified in ASHRAE 15 for the refrigerant type to be used in the system.

d. Repair any leaks and repeat tests until no further leaks are found and the system passes a static leak test at test pressure for a duration of 24 HRS.

3. Cleaning

a. Disconnect suction and discharge lines from compressor for clean up after complete system is tested.

b. Valve or blank off system into three separate systems for purpose of cleanup.

1) Suction side including cooling coils.

2) Discharge side including air cooled condenser.

3) Hot gas reheat side including heating DX coils.

c. Thoroughly clean each system using pumped refrigerant until system is proven clean to satisfaction of refrigeration compressor serviceman.

d. Notify Engineer for a visual inspection of both cleaning process and completely cleaned system.

4. Evacuation and Drying

a. After tests and cleaning have been completed and system proved tight, charge each circuit with dry clean refrigerant to gas pressure as recommended by the equipment manufacturer.

b. Evacuate to 100-micron Hg and hold for 72 HRS.

1) Use laboratory type vacuum pump capable of holding absolute pressure of 50-micron Hg.

2) Check the vacuum with a suitable mercury column gauge.

c. Admit another drying charge of refrigerant and allow 4 to 6 HRS to absorb moisture and install dryer cores.

d. Use second evacuation to remove all refrigerant and moisture.

e. After second evacuation, charge system with refrigerant.

f. Charge the system with refrigerant as required after final evacuation.

## 2.03 CONDENSATE DRAIN PIPE

A. Poly (Vinyl Chloride) Pipe and Fittings

1. Pipe: Drain, waste and sanitary pipes and fittings shall be DWV Schedule 40 PVC, ASTM D2665.

2. Joints: Chemical weld with manufacturers recommended solvent.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. All installation shall be in accordance with manufacturer's published recommendations.

B. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation of the Engineer.

C. Provide the minimum access space for maintenance of filters and coils as scheduled or shown on the Drawings. Arrange these components in a manner that allows for ease of replacement.

## 3.02 CLEANING

A. Clean dirt and marks and other debris from exterior of equipment.

B. Remove debris and waste material resulting from installation.

## 3.03 GUARANTEE

A. All components, parts, and assemblies shall be guaranteed against defects in materials and workmanship for a period of 1 year. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the 30-day operational period after the equipment startup. If the equipment does not perform satisfactorily during the 30-day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.

**END OF SECTION**

## SECTION 23 82 16
## ELECTRIC-RESISTANCE AIR COILS

### PART 1 – GENERAL

### 1.01 REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all electric space heating units as required for a complete electric installation as specified herein and indicated on the Drawings.

B. The extent of the electric space heaters work is indicated on the Drawings and further defined by the requirements of this Section. The Contractor shall reference the Schedule included herein or indicated on the Drawings for quantities, electrical ratings, ventilation ratings, and other unit specific information.

C. All field mounted equipment, conduit, and wiring that is required to for the heating equipment shall conform the applicable requirements of Division 26.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 00 00 – Basic HVAC Requirements

B. Section 23 05 93 – HVAC Balancing

C. Section 23 05 95 – HVAC Field Testing

D. Section 23 31 13 – Metal Ducts and Duct Accessories

E. Division 26 – Electrical

F. Section 40 05 00 – Basic Mechanical Requirements

### 1.03 TESTING

A. All tests shall be performed in accordance with the requirements of Section 00 72 00 – General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests: The electric space heating units shall be given routine factory tests in accordance with the requirements of the appropriate standards.

2. Field Tests: Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 01, and Section 26 05 00 – Basic Electrical Requirements. The tests shall be made by the Contractor who shall also furnish the required testing equipment.

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## 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures and Division 01, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Special Tools List
3. Reports of Certified Shop Tests
4. Operation and Maintenance Manuals
5. Testing Procedure per Section 23 05 95 – HVAC Field Testing and Section 23 08 00 – Commissioning of HVAC System.
6. Manufacturer’s Installation Certification
7. Manufacturer’s Field Test Results Certification

B. Each submittal shall be identified by the applicable Specification Section.

## 1.05 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets identifying all materials used and methods of fabrication.
2. Example equipment nameplate data sheet.
3. Complete wiring diagrams showing all devices requiring electrical connection, wire numbers, terminal block numbers and other pertinent wiring information.

## 1.06 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in Section 00 72 00 – General Conditions and Division 01.

## 1.07 SPECIAL TOOLS

A. The electric space heating units shall be furnished with all special tools necessary (one set per like piece of equipment) to disassemble, service, repair and adjust the equipment.

## 1.08 IDENTIFICATION

A. Each electric space heating unit shall be identified with the identification number on the Drawings (e.g., UH-1, UH-2). A nameplate shall be securely affixed in a conspicuous place on each unit. Nameplates shall be as specified in Section 26 05 00 – Basic HVAC Requirements.

## 1.09 WARRANTY

A. Manufacturer shall provide a 1-year comprehensive warranty.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURER

A. The equipment covered by this Section is intended to be standard equipment of proven performance as manufactured by reputable firms regularly engaged in the manufacturing of electric space heating units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

## 2.02 ELECTRIC UNIT HEATERS

A. Product and Manufacturers: Provide completely factory assembled and wired units as made by one of the following:

1. Indeeco UHIR Unit Heater
2. Chromalox HVH Unit Heater
3. Approved Equal

B. Capacity and electrical supply characteristics shall be as shown on the Drawings.

C. Construction

1. Unit shall be UL listed.
2. Finned tubular heating elements shall be brazed copper plated steel fins and epoxy sealed ends.

3. The motor shall be UL rated, permanently lubricated ball bearings, designed to resist moisture and corrosion.

4. Heating elements and motor shall be enclosed in a heavy gauge galvanized steel cabinet with a durable polyester powder coat finish.

5. The unit shall contain an adjustable outlet grille.

6. The unit shall be wired for single point power connection.

7. The enclosure shall house the element terminals and the following factory pre-wired controls:

    a. Automatic reset over temperature cutout

    b. Secondary manual reset/over temperature cutout

    c. 24V Control transformer

    d. Fan delay relay

    e. Terminal blocks for field wiring

    f. Three position selector switch (Auto, Off, Fan Only)

    g. Internal thermostat with external adjustable knob

    h. “Heater On” Pilot light to indicate when heating elements are energized

D. The Contractor shall furnish universal swivel mounting brackets. The mounting bracket shall be suitable for horizontal wall mounting or vertical ceiling or suspended mounting.

## PART 3 – EXECUTION

### 3.01 STORAGE AND HANDLING

A. The Contractor shall handle the unit heaters and components carefully to prevent damage, breaking, denting, and scoring. Contractor shall not install damaged electric unit heaters or components.

B. The Contractor shall store the unit heaters and components in a clean dry place, which will adequately protect the units from weather, dirt, fumes, water, construction debris, and physical damage.

C. The Contractor shall comply with the manufacturer's rigging and installation instructions for unloading unit heaters and moving them to final location.

## 3.02 INSTALLATION

A. The Contractor shall install unit heaters as indicated on the Contract Drawings, in accordance with the manufacturer's installation instructions, and shall verify that the manufacturer's nameplate data corresponds with the unit designation.

B. The Contractor shall hang/support the units from substantial structural components of the building (e.g., walls, floors, columns, beams). Supports for the units and associated ductwork supports for insertion type installations shall not be hung from piping, other ductwork, or other equipment supports. After installation, the unit shall be protected with a protective cover during the balance of construction.

C. The Contractor shall have the Manufacturer’s Technical Representative provide in writing that the equipment is installed per the manufacturer’s requirements and operates as required by the Contract. The Contractor shall submit the written confirmation to the Engineer for information only.

## 3.03 TESTING, ADJUSTING, AND CLEANING

A. After installation is completed, the Contractor shall clean all exposed unit surfaces, vacuum the heating coils and vacuum the inside of the cabinets.

B. See Section 23 05 93 – HVAC Balacning and Section 23 05 95 – HVAC Field Testing for testing and adjusting requirements.

## 3.04 MANUFACTURER’S FIELD SERVICES

A. The services of a qualified manufacturer's Technical Representative shall be provided. The manufacturer Technical Representative’s services shall include the following site visits:

| Service | Total Days | No. of Trips | Remarks |
|---|---|---|---|
| Installation Checkout | 1 | 1 | In accordance with Section 23 08 00 – Commissioning of HVAC System |
| Startup and Testing | 2 | 2 | In accordance with Section 23 05 95 – HVAC Field Testing |

**END OF SECTION**

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## Cherokee County Water & Sewerage Authority

Fitzgerald Creek Water Pollution Control Plant

# PROJECT MANUAL

## FOR

## Fitzgerald Creek WPCP Thermal Dryer Facility

## November 2025

## BIDDING DOCUMENTS

## VOLUME 3 OF 4

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| 05 56 00 | Castings |


**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**


| Section | Title |
|---|---|
| 06 10 00 | Rough Carpentry |

**DIVISION 07 – THERMAL AND MOISTURE PROTECTION**


| Section | Title |
|---|---|
| 07 21 00 | Building Insulation |
| 07 60 00 | Flashing and Sheet Metal |
| 07 60 50 | Metal Wall and Roof Panels |
| 07 70 00 | Roof Specialties and Accessories |
| 07 84 00 | Firestopping |
| 07 90 00 | Joint Fillers, Sealants and Caulking |


**DIVISION 08 – OPENINGS**


| Section | Title |
|---|---|
| 08 11 16 | Aluminum Doors and Frames |
| 08 33 23 | Roll-up Doors |
| 08 71 00 | Finish Hardware |
| 08 80 00 | Glass and Glazing |
| 08 90 00 | Louvers |


**DIVISION 09 – FINISHES**


| Section | Title |
|---|---|
| 09 90 00 | Painting |


**DIVISION 10 – SPECIALTIES**


| Section | Title |
|---|---|
| 10 14 00 | Identifying Devices |
| 10 43 16 | First Aid Cabinets |
| 10 44 16 | Fire Extinguishers |


**DIVISION 11 – EQUIPMENT (NOT USED)**

**DIVISION 12 – FURNISHINGS (NOT USED)**

**DIVISION 13 – SPECIAL CONSTRUCTION**


| Section | Title |
|---|---|
| 13 34 19 | Metal Buildings |


**DIVISION 14 – CONVEYING EQUIPMENT (NOT USED)**

**DIVISION 21 – FIRE SUPPRESSION**


| Section | Title |
|---|---|
| 21 05 00 | Basic Fire Suppression Requirements |
| 21 05 29 | Hangers and Supports for Fire Suppression Piping and Equipment |
| 21 05 48 | Vibration and Seismic Controls for Fire Suppression Piping and Equipment |
| 21 05 53 | Identification for Fire Protection, Mechanical Process, and Life Safety System Equipment |
| 21 13 13 | Wet Pipe Sprinklers |
| 21 13 24 | Fluorine-Free Foam Fire Suppression System |


**DIVISION 22 – PLUMBING**


| Section | Title |
|---|---|
| 22 05 00 | Basic Plumbing Requirements |
| 22 05 19 | Meters and Gauges for Plumbing Piping |
| 22 05 29 | Hangers and Supports for Plumbing Piping and Equipment |
| 22 05 48 | Vibration and Seismic Controls for Plumbing Piping and Equipment |
| 22 05 53 | Identification for Plumbing Piping and Equipment |
| 22 07 19 | Plumbing Piping Insulation |
| 22 08 00 | Commissioning of Plumbing System |
| 22 10 14 | Facility Natural Gas Piping |
| 22 11 13 | Facility Water Distribution Piping |
| 22 11 19 | Domestic Water Piping Specialties |

| Section | Title |
|---|---|
| 22 13 16 | Sanitary Waste and Vent Piping |
| 22 13 19 | Sanitary Waste Piping Specialties |
| 22 15 00 | General Service Compressed Air |
| 22 33 00 | Electric Domestic Water Heaters |


**DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**


| Section | Title |
|---|---|
| 23 00 00 | Basic HVAC Requirements |
| 23 05 48 | Vibration and Seismic Controls for HVAC |
| 23 05 93 | HVAC Balancing |
| 23 05 95 | HVAC Field Testing |
| 23 07 00 | HVAC Insulation |
| 23 08 00 | Commissioning of HVAC System |
| 23 09 01 | HVAC Automatic Temperature Controls (Relay Logic) |
| 23 23 00 | Refrigerant Piping |
| 23 31 13 | Metal Ducts and Duct Accessories |
| 23 34 00 | HVAC Fans |
| 23 51 00 | Breechings, Chimneys, and Stacks |
| 23 55 33 | Gas-Fired Unit Heaters |
| 23 74 01 | Commercial Air Handling Units for Indoor or Outdoor Applications |
| 23 74 05 | Positive Pressurization Units |
| 23 75 00 | Custom-Packaged HVAC Equipment |
| 23 81 26 | Split-System Air Conditioners |
| 23 82 16.14 | Electric-Resistance Air Coils |

**DIVISION 25 – INTEGRATED AUTOMATION (NOT USED)**

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**DIVISION 26 – ELECTRICAL**


| Section | Title |
|---|---|
| 26 05 00 | Basic Electrical Requirements |
| 26 05 19 | Low-Voltage Conductors and Cables |
| 26 05 26 | Grounding and Bonding for Electrical Systems |
| 26 05 29 | Hangers and Supports for Electrical Systems |
| 26 05 33.13 | Conduit for Electrical Systems |
| 26 05 33.16 | Boxes for Electrical Systems |
| 26 05 53 | Identification for Electrical Systems |
| 26 05 60 | Low-Voltage Electric Motors |
| 26 05 73 | Power System Studies |
| 26 09 16 | Electric Controls and Relays |
| 26 22 00 | Low-Voltage Transformers |
| 26 24 16 | Panelboards |
| 26 24 19 | Low-Voltage Motor Control Centers |
| 26 27 26 | Wiring Devices |
| 26 28 16.16 | Enclosed Switches |
| 26 29 23 | Low-Voltage Variable Frequency Motor Controllers |
| 26 41 00 | Facility Lightning Protection |
| 26 43 13 | Surge Protective Devices |
| 26 50 00 | Lighting |


**DIVISION 27 – COMMUNICATIONS (NOT USED)**

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**


| Section | Title |
|---|---|
| 28 46 20 | Fire Alarm Systems |

**DIVISION 31 – EARTHWORK**


| Section | Title |
|---|---|
| 31 00 01 | Earthwork |
| 31 05 16 | Aggregate Materials |
| 31 05 19 | Geotextiles |
| 31 10 00 | Clearing, Grubbing, and Site Preparation |
| 31 23 24 | Flowable Fill |
| 31 25 00 | Erosion and Sedimentation Control |


**DIVISION 32 – EXTERIOR IMPROVEMENTS**


| Section | Title |
|---|---|
| 32 10 00 | Paving and Surfacing |
| 32 11 00 | Surface Restoration |
| 32 90 00 | Final Grading and Landscaping |


**DIVISION 33 – UTILITIES**


| Section | Title |
|---|---|
| 33 05 61 | Utility Structures |
| 33 24 00 | Storm Drains and Roof Drains |
| 33 71 19 | Underground Electrical |


**DIVISION 34 – TRANSPORTATION (NOT USED)**

**DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION (NOT USED)**

**DIVISION 40 – PROCESS INTERCONNECTIONS**


| Section | Title |
|---|---|
| 40 05 00 | Basic Mechanical Requirements |
| 40 05 07 | Pipe Supports |
| 40 05 19 | Ductile Iron Pipe |

| Section | Title |
|---|---|
| 40 05 24.23 | Steel Pipe for Water and Wastewater Service |
| 40 05 24.43 | Steel Pipe for Miscellaneous Service |
| 40 05 31 | PVC/CPVC Pipe |
| 40 05 36.13 | FRP Ductwork for Odor Control Service |
| 40 05 41 | Piping Expansion Compensation for Liquid Service |
| 40 05 51 | Valves, General |
| 40 05 57 | Valve Operators and Electric Valve Actuators |
| 40 05 58 | Gate Operators and Electric Gate Actuators |
| 40 05 59.23 | Fabricated Stainless Steel Slide Gates |
| 40 05 61 | Gate Valves (Including Knife Gate Valves) |
| 40 05 62 | Eccentric Plug Valves |
| 40 05 63 | Ball Valves |
| 40 05 64 | Butterfly Valves |
| 40 05 65.23 | Check Valves |
| 40 05 68.13 | PVC and CPVC Valves |
| 40 05 68.23 | Miscellaneous Valves |
| 40 05 78 | Air Valves for Water and Wastewater Service |
| 40 05 81 | Fire, Wall, and Yard Hydrants |
| 40 05 89.13 | Basket Strainers for Process Service |
| 40 05 97 | Piping and Equipment Identification Systems |
| 40 06 20 | Process Pipe, Valve, and Gate Schedules |
| 40 42 13 | Insulation |
| 40 61 13 | Process Control System General Provisions |
| 40 61 15 | Process Control System Submittals |
| 40 61 21 | Process Control System Testing |
| 40 61 21.71 | Factory Witness Test |
| 40 61 21.72 | Field Testing |
| 40 61 21.73 | Final Acceptance Test |
| 40 61 22 | Tools, Supplies, and Spare Parts, General |

| Section | Title |
|---|---|
| 40 61 23 | Signal Coordination Requirements |
| 40 61 24 | Quality Assurance |
| 40 61 91 | Process Control System Instrument List |
| 40 61 93 | Process Control System Input/Output List |
| 40 61 96 | Process Control Descriptions |
| 40 62 00 | Computer System Hardware and Ancillaries |
| 40 63 43 | Programmable Logic Controllers |
| 40 66 00 | Network and Communication Equipment |
| 40 67 00 | Control System Equipment Panels and Racks |
| 40 67 63 | Uninterruptible Power Systems |
| 40 68 00.13 | Process Control Software (Modify) |
| 40 70 00 | Instrumentation for Process Systems |
| 40 71 79.16 | Flow Switches (Thermal) |
| 40 72 76.26 | Level Switches (Floats) |
| 40 73 13 | Pressure and Differential Pressure Gauges |
| 40 76 21 | Single Point Gas Monitoring Systems |
| 40 78 00 | Panel Mounted Instruments |
| 40 78 56 | Isolators, Intrinsically Safe Barriers, and Surge Suppressors |
| 40 79 00 | Miscellaneous Instruments, Valves, and Fittings |

**DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT**

| Section | Title |
|---|---|
| 41 22 00 | Cranes and Hoists |

**DIVISION 42 – PROCESS HEATING, COOLING, AND DRYING EQUIPMENT (NOT USED)**

**DIVISION 43 – PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT**


| Section | Title |
|---|---|
| 43 20 00 | Pumps – General |
| 43 25 13.10 | Wet Pit Submersible Solids-Handling Pumps |


**DIVISION 44 – POLLUTION AND WASTE CONTROL EQUIPMENT (NOT USED)**

**DIVISION 45 – INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT (NOT USED)**

**DIVISION 46 – WATER AND WASTEWATER EQUIPMENT**


| Section | Title |
|---|---|
| 46 00 00 | Equipment General Provisions |
| 46 07 01 | Packaged Control Panels |
| 46 76 42 | Screw Conveyors |
| 46 76 70 | Indirect Thermal Sludge Drying System |


**DIVISION 48 – ELECTRICAL POWER GENERATION (NOT USED)**

**APPENDICES**


| Appendix | Title |
|---|---|
| A | Geo-Hydro Engineers, Inc. Report of Subsurface Exploration and Geotechnical Engineering Evaluation (Information of Record) |
| B | Existing Record Drawings for Select Items/Structures to be Demolished/Removed (Information of Record) |

## SECTION 26 05 00
## BASIC ELECTRICAL REQUIREMENTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental to, the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents, and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in, and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.

B. Reference Section 40 61 13 – Process Control System General Provisions and General Requirements in Division 01 for scope of work details as they relate to Division 40.

C. The electrical scope of work for this Project primarily includes, but is not limited to, the following:

1. Demolition of electrical equipment and raceway systems as shown on the Drawings.

2. Modifications to existing electrical equipment as shown on the Drawings and as specified herein.

3. Furnish and install low-voltage motor control equipment including reduced voltage motor starters and variable frequency drives.

4. Furnish and install power panelboards, lighting panelboards, dry-type transformers, and other low-voltage electrical power distribution equipment.

5. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.

6. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.

7. Furnish and install low and voltage wire and cable resulting in a complete and operable electrical system.

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8. Furnish and install new lighting systems and wiring devices.

9. Furnish and install facility lightning protection systems and grounding systems where specified or indicated on the Drawings.

10. Furnish and install fire alarm systems where specified or indicated on the Drawings.

11. Other electrical work as specified herein and indicated on the Drawings.

D. All material and equipment shall be the product of an established, reputable, and approved manufacturer; shall be new and of first-class construction; shall be designed and guaranteed to perform the service required; and shall bear the Label of approval of UL, where such approval is available for the product of the listed manufacturer as approved by the Engineer.

E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.

G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

H. All electrical components and systems (e.g., conduit and other raceways, freestanding equipment) and their anchorage, including electrical equipment foundations, shall be designed to resist the controlling load combination of gravity loads, operational forces, wind forces, seismic forces, thermal loads, and any other applicable forces required in accordance with the governing Building Code and Section 01 73 23 – Anchorage and Bracing of Nonstructural Components. Seismic design shall be in accordance with ASCE 7 Chapter 13 unless the nonstructural component meets the criteria to be exempt.

## 1.02 EQUIPMENT LOCATION

A. The Drawings show the general location of feeders, transformers, equipment, devices, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting the work and shall arrange such work accordingly. Contractor shall furnish and install such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to

the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.

B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

## 1.03 LOCAL CONDITIONS

A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction (AHJs). All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project. Costs for such work shall be included in the Bid.

C. The contact person at the serving electrical utility is:

Jeff Dickerson, Engineering Design Technician Sr.
Cobb EMC
678-355-3458
Jeff.Dickerson@cobbemc.com

## 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures and the requirements of the individual Specification Sections, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Proposed Testing Methods and Reports of Certified Shop Tests

5. Reports of Certified Field Tests

6. Manufacturer’s Representative’s Certification

B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.

C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.

D. Some individual electrical Specification Sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations, and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of the applicable Specification Section(s). In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations and exceptions taken to each Drawing related to the applicable Specification Section(s).

E. Submit design for all nonstructural electrical components and systems and their anchorage in accordance with the governing Building Code and Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

## 1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. Unless otherwise noted, all work, equipment, and materials furnished shall conform with the latest available version of the rules, requirements, and specifications of the following:

a. Insurance Rating Organization having jurisdiction

b. The serving electric utility company

c. The currently adopted edition of the NEC

d. NEMA

e. IEEE

f. ICEA

g. ASTM

h. ANSI

i. The requirements of OSHA

j. NECA Standard of Installation

k. NFPA

l. NETA

m. All other applicable Federal, state, and local laws and/or ordinances.

2. All equipment and materials shall be Listed by and shall bear the Label of UL, if the material and equipment is of the type/class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications or Drawings deviating from the rules, requirements, and specifications of the previously listed organizations shall be invalid and their (the previously listed organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements, and specifications as previously set forth herein. Any additional work or material necessary for adherence will not be allowed as an extra but shall be included in the Bid. Ignorance of any rule, requirement, or specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Where applicable, upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

## 1.06 PERMITS AND INSPECTIONS

A. The Contractor shall reference the General Conditions and Section 01 11 00 – Summary of Work.

## 1.07 TEMPORARY LIGHTING AND POWER

A. The Contractor shall reference the General Conditions and Section 01 51 00 – Temporary Utilities.

## 1.08 TESTS

A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.

B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five times.

C. Refer to each individual Specification Section for detailed test requirements.

D. The Contractor shall complete the installation and field testing of the electrical installation at least 2 weeks prior to the start-up and testing of any equipment served by that electrical equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, personnel, and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any electrical equipment required as part of the field tests of other systems.

## 1.09 INFRARED INSPECTION

A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations. The infrared inspection shall be performed by a qualified, independent, third-party testing company, not the electrical subcontractor.

B. Equipment located in hazardous areas shall be excluded from infrared testing requirements since the equipment in those areas is not intended to be operated while the enclosure is open. The infrared inspection shall apply to all new equipment and existing equipment in non-hazardous areas that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the scope of this Contract shall be corrected by the Contractor at no additional cost to the Owner. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor at no additional cost to the Owner.

C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not

being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.

D. The infrared inspection report shall include both digital photos and infrared (IR) photos positioned side by side. Both the digital and IR photos shall be clear and high quality. Fuzzy, grainy, or poorly illuminated photos are not acceptable. Each IR photo shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in the photo. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

## 1.10 PROTECTIVE DEVICE SETTING AND TESTING

A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the modified portions of the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.

B. All protective devices in the electrical equipment shall be set, adjusted, calibrated, and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.

C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity, and polarity tests of power, protective, and metering circuits. Any minor adjustments, repairs, and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.

D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers' recommended test devices and procedures.

E. Circuit breakers and/or contactors associated with the previously listed devices shall be tested for trip and close functions with their protective device.

F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults, and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.

G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

## 1.11 POWER SYSTEM STUDIES

A. The Contractor shall provide power system studies performed by a licensed Professional Engineer in accordance with Section 26 05 73 – Power System Studies.

## 1.12 SCHEDULES AND FACILITY OPERATIONS

A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules shall be submitted to the Engineer for review and approval 1 month prior to any work beginning. When testing has been scheduled, the Engineer shall be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment shall be coordinated with the Owner/Engineer so as not to affect proper facility operations.

B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.

C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference Section 01 14 00 – Coordination with Owner's Operations for construction sequencing and specific operational constraint information.

## 1.13 EQUIPMENT, MATERIALS, AND SPARE PARTS HANDLING AND STORAGE

A. Materials arriving on the Project Site shall be stored in such a manner as to keep material free of rust and dirt and to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01 55 00 – Contractor Access and Parking.

B. Spare parts lists, included with the shop drawing submittal for each Section, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Spare parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate

number. Those parts which are identical for more than one size, shall have the same parts number.

D. Spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

E. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.

### 1.14 WARRANTIES

A. Unless otherwise specified in an individual Specification Section, all electrical equipment and electrical construction materials shall be provided with a warranty in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and the General Conditions.

### 1.15 TRAINING

A. Unless otherwise specified in an individual Specification Section, all training for electrical equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

## PART 2 – PRODUCTS

### 2.01 PRODUCT REQUIREMENTS

A. Unless otherwise indicated, the materials to be provided under this Section shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.

C. All equipment and materials shall be new, unless indicated or specified otherwise.

D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, and/or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc. with regard to fire and casualty hazards. Documentation indicating Listing and Labeling by Underwriters Laboratories, Inc., will be accepted as meeting this requirement.

E. Where the previously listed items are Labeled by (bearing the certification mark of) an OSHA Nationally Recognized Testing Laboratory (NRTL) other than UL, and the NRTL is authorized by OSHA to test and certify those items to the same standard(s), then the certification mark of that NRTL shall be considered equivalent to the 'UL' certification mark.

## 2.02 SUBSTITUTIONS

A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

## 2.03 CONCRETE

A. The Contractor shall furnish all concrete required for the installation of all electrical work. Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 03 of the Specifications.

B. The Contractor shall provide concrete equipment pads for all free-standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to the Standard Detail for equipment pads shown on the Drawings. Equipment pads shall not have more than 3 inches of excess concrete beyond the edges of the equipment.

C. The Contractor shall provide concrete foundations for all free-standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick, minimum, reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or GAB) 6 inches thick, minimum.

## 2.04 RUBBER INSULATING MATTING

A. Rubber insulating matting shall be furnished and installed for each piece of electrical equipment that is located indoors and installed under this Contract. Rubber insulating matting shall not be installed outdoors. Matting shall be installed in the front of all equipment and in the rear of equipment that is rear accessible. The mat shall be long

enough to cover the full length of the equipment. The mat shall be 1/4-inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The matting shall meet OSHA requirements and the requirements of ASTM D178 for Type 2, Class 2 insulating matting. Matting shall be 36 inches wide, minimum. However, matting width shall be no less than the NEC working clearance for the equipment with which it is associated.

B. Matting shall be provided for the following equipment:

1. PLC/RTU Enclosures
2. Control Panels
3. Motor Control Centers
4. Variable Frequency Drives
5. Panelboards
6. Fire Alarm Control Panels

## PART 3 – EXECUTION

### 3.01 CUTTING AND PATCHING

A. Coordination

1. The electrical work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling, and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling, and patching necessary to the proper execution of this Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at the Contractor’s expense.

C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure.

Covers and plugs shall be watertight when installed in equipment located outdoors.

## 3.02 EXCAVATION AND BACKFILLING

A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 31.

## 3.03 CORROSION PROTECTION

A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, 9-mil polyethylene tape, or gaskets.

**END OF SECTION**

## SECTION 26 05 19
## LOW-VOLTAGE CONDUCTORS AND CABLES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition all low-voltage wire and cable indicated on the Drawings, as specified herein, and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.

B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.

C. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 33.16 – Boxes for Electrical Systems

3. Section 26 28 16.16 – Enclosed Switches

### 1.02 CODES AND STANDARDS

A. All low-voltage wire, cable, and appurtenances shall be Listed by and shall bear the Label of UL.

B. Low-voltage wire, cable, and appurtenances shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. ASTM

a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire

b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

d. ASTM D69 – Standard Test Methods for Friction Tapes

e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

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2. IEEE

    a. IEEE 1202 – Standard for Flame Testing of Cables

3. ICEA

    a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification

    b. ICEA T-29-520 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour

4. NFPA

    a. NFPA 70 – National Electrical Code (NEC)

5. UL

    a. UL 13 – Standard for Power-Limited Circuit Cables

    b. UL 44 – Thermoset-Insulated Wires and Cables

    c. UL 83 – Thermoplastic-Insulated Wires and Cables

    d. UL 486A-486B – Standard for Safety Wire Connectors

    e. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members

    f. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords

    g. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

    h. UL 2250 – Standard for Instrumentation Tray Cable

    i. UL 2556 – Wire and Cable Test Methods

**1.03 SUBMITTALS**

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the wire and cable manufacturer and submit the following:

1. Shop Drawings

2. Cable Pulling Plan (if required)

3. Reports of Field Tests

4. Circuit Logs

B. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for the following:

a. Wire and cable

1) The product data sheets for wire and cable for up to four manufacturers for each type of wire/cable specified herein will be reviewed if they are submitted at the same time under the same submittal cover for simultaneous review.

b. Power and control wire terminations, including wire ferrules

c. Instrumentation cable terminations

d. Shielded VFD cable terminations

e. Pulling lubricant

2. Wiring identification methods and materials.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of 10 years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

### 2.02 POWER AND CONTROL WIRE AND CABLE

A. Power wire installed between the output terminals of a VFD and the respective motor shall be shielded VFD cable as specified herein.].

B. Power wire for all other loads and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.

C. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B8 and ASTM B3, with Class B or C stranding contingent upon the size. Power conductors for lighting and receptacle branch circuits shall be solid copper per ASTM B3.

D. Power conductor size shall be no smaller than No. 12 AWG and Control conductor size shall be no smaller than No. 14 AWG.

E. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

F. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or Engineer approved equal.

### 2.03 INSTRUMENTATION CABLE

A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e., groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e., group shields) and an overall cable

shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.

D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B8, with Class B stranding unless otherwise specified.

E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.

F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or Engineer approved equal.

G. Special Instrumentation Cables for Indirect Thermal Sludge Drying System Equipment: Contractor shall provide the following cables where shown on the Drawings:

| Cable Type | Description | Model Number and Manufacturer |
|---|---|---|
| T1 | Type “T” thermocouple duplex insulated Extension wire, Neoflon PFA Insulation, -60 to 100°C, solid, 24 AWG, ANSI | EXTT-24-SLE by Omega Engineering, NO SUBSTITUTIONS |
| T2 | Type “T” twisted shielded insulated thermocouple duplex extension wire, PVC single conductor and duplex insulation, aluminized polyester shield with drain wire, 20 AWG, ANSI Type TX, UL-Listed | EXPP-T-20S-TWSH-UL by Omega Engineering, NO SUBSTITUTIONS |

## 2.04 SHIELDED VFD CABLE

A. Where indicated on the Drawings, shielded VFD cable shall be installed between the output terminals of a VFD and the respective motor.

B. Shielded VFD cable shall consist of three individually insulated copper phase conductors and three bare copper grounding conductors with an overall cable shield and jacket, suitable for use with variable frequency drives. The phase conductors and ground conductors shall be symmetrically arranged within the cable assembly. Conductor insulation shall be rated 90°C in both wet and dry locations, and 2000V (2kV). Insulated conductors shall be UL Listed as NEC Type RHW-2 or XHHW-2. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL Listed as NEC Type TC-ER (Tray Cable for Exposed Runs).

C. Phase conductors shall be sized as shown on the Drawings. Ground conductors shall have a combined circular mil area equivalent to the equipment grounding conductor size required by NEC Table 250.122, minimum. Filler material shall be included in the cable assembly as necessary to make the cable round.

D. Cable shields shall consist of a helically applied bare copper tape with 50% overlap, minimum. For small conductor sizes where copper tape shields are not available, shields shall be permitted to consist of a layer of tin-coated copper braid covered by a layer of overlapped aluminum/polyester tape/foil. All cable shields shall provide 100% coverage.

E. Conductors shall be annealed stranded copper per ASTM B3 and B8.

F. Shielded VFD cable shall be manufactured by Belden Wire and Cable, the Okonite Company, General Cable, Southwire, or AmerCable Inc.

## 2.05 OTHER CABLES

A. Category 6 UTP communication cables and fiber optic cables shall be as specified in Specification Section 40 66 00 – Network and Communication Equipment.

## 2.06 CONDUCTOR IDENTIFICATION

A. Conductors shall be identified using a color-coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

1. 480/277V AC Power

    a. Phase A – BROWN

    b. Phase B – ORANGE

    c. Phase C – YELLOW

    d. Neutral – GREY

2. 120/208V or 120/240V AC Power

    a. Phase A – BLACK

    b. Phase B – RED

    c. Phase C – BLUE

    d. Neutral – WHITE

3. DC Power

    a. Positive Lead – RED

b. Negative Lead - BLACK

4. DC Control

a. All wiring – BLUE

5. 120VAC Control

a. 120VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock. This interlock conductor shall be color coded YELLOW. For the purposes of this Section, an interlock is defined as any wiring that brings voltage into the above-mentioned equipment from a source outside that equipment.

6. 24VAC Control

a. All wiring - ORANGE

7. Equipment Grounding Conductor

a. All wiring - GREEN

B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color-coding requirements listed above.

C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color-coding requirements listed above.

## 2.07 CABLE PULLING LUBRICANTS

A. Cable pulling lubricants shall be non-hardening, non-wax-based type and approved for use on the type of cable installed. Lubricant shall be Polywater J by Polywater, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

## PART 3 – EXECUTION

### 3.01 CABLE PULLING PLANS

A. The Contractor shall submit cable pulling plans for Engineer approval at least 10 working days prior to making any cable pull in which all of the following are true:

1. The amount of cable to be installed will be greater than 200 linear feet between pull points.

2. The installation will have one or more bends.

3. The wire/cable is size #1/0 AWG and larger.

B. Each cable pulling plan shall consist of the following minimum elements:

1. Site plan and/or building plan view drawings (as appropriate) explicitly annotated with the following information:

a. Locations of the cable reels and cable tugging device

b. Locations of any pull out/pull in points along the path of the pull between the cable reels and the tugging device

c. Locations of all manholes, handholes, pull boxes, vaults, and termination cabinets

d. Locations of all cable splices (where splices are explicitly permitted herein)

e. Locations of each cable pull segment number which corresponds to the segment numbers listed in the pulling calculations

f. Listing of pulling hardware (radius rollers, tripods, forklift, etc.) being used at the start and end of the pull as well as at each of the manholes, handholes, vaults, and pull boxes in between

2. Cable pulling calculations performed by a currently registered Professional Engineer in the state of Georgia. Pulling calculations requirements are as follows:

a. Show pulling tension and sidewall pressure values for each cable pull segment with cable pull segment numbers corresponding to those listed in the annotated plan views. Pulling tension and sidewall pressure values shall not exceed the maximum values allowed by the cable manufacturer.

b. Show pull segment lengths, bend types, bend radii, and bend direction (up, down, horizontal).

c. Use the minimum radius allowed by the NEC for each conduit bend unless evidence (submittals, pictures, etc.) can be provided to substantiate the use of large bending radii in the calculations.

## 3.02 WIRE AND CABLE INSTALLATION

A. General

1. All wire and cable furnished under this Contract, including wire and cable furnished under other Divisions, shall be installed in raceways (e.g., conduit) unless specifically noted otherwise.

2. Wire and cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.

3. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.

4. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

5. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.

2. Splicing materials shall be UL 486A Listed barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.

3. No splicing of control or instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.

D. Additional Conductor Identification

1. In addition to the color-coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.

2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.

3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.

5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.

6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.

7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.

8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that specific conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle using nylon wire ties and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.

2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:

a. 18 inches for 480/277VAC wiring

b. 12 inches for 208/120VAC wiring

c. 6 inches for 24VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment Specification Sections as applicable for additional termination requirements.

2. For conductors with stranding other than Class B or C, a UL 486A Listed wire ferrule shall be installed prior to each conductor termination. Ferrules shall be

suitable for the size of conductors and shall be made of a material that is compatible with the conductors. Ferrules shall be crimped on in accordance with the ferrule manufacturer's instructions.

3. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 26 05 33.16 – Boxes for Electrical Systems, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.

4. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

5. Shielded VFD cables shall be terminated with kits required by or recommended by the approved shielded VFD cable manufacturer. Termination kits shall be installed in strict accordance with the shielded VFD cable manufacturer's and termination kit manufacturer's instructions. Where disconnect switches are shown on the Drawings to be installed on circuits utilizing shielded VFD cables, the installation shall be coordinated and executed as specified in Specification Section 26 28 16.16 – Enclosed Switches.

6. To minimize oxidation and corrosion, selected wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for electrical connections. The compound shall be Penetrox E for copper-to-copper connections, and Penetrox A for all other connections, as manufactured by Burndy Electrical, or equal. The joint compound shall be used in the following installations:

    a. Termination of aluminum conductors, where aluminum conductors are specifically allowed by the Engineer.

    b. Terminations in all Class I and Class II, Division 1 and 2 hazardous areas.

7. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a 3-day period prior to pulling, the cable reels shall be stored 3 days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the workday for which the cable is removed from the protected

storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

I. Circuit Log

1. The Contractor shall maintain a written log of installed circuit lengths for all single-phase and three-phase power circuits operating at 208VAC or greater. The log shall be organized in a tabular format, recording the following items for each circuit:

a. Circuit ID or Conduit ID(s) as shown on the Drawings

b. From (originating equipment)

c. To (terminating equipment)

d. Conductor sizes and counts

e. Conductor length

## 3.03 TESTING

A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Shop Tests

a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

2. Field Tests

a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.

b. After installation, wires and cables shall be tested for insulation resistance levels between conductors of the same circuit and between conductor and ground as follows:

1) For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for 1) minute. Resistance shall be no less than 100 Megohms.

2) Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter or approved equal. The resistance value shall be 200 Megohms or greater.

3) Insulation resistance testing is not required for power and control cables smaller than #8 AWG.

c. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.

d. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.

e. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

**Exhibit A**
**Test Data – Megohms**
**Test No. ____**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date: | | | Company: | | | | |
| Time: | | | Location: | | | | |
| Circuit: | Circuit Length: | Aerial: | Duct: | Buried: | No. of Conductors | Size: | AWG MCM Shield: |
| Insulation Material: | | | Insulation Thickness: | | Voltage Rating: | | Age: |
| Type: _____ Pothead _____ Terminal | | | | | Location: Indoors _____ Outdoors _____ | | |
| Number and Type of Joints: | | | | | | | |
| Recent Operating History: | | | | | | | |
| Manufacturer: | | | | | | | |
| State if Potheads or Terminals were grounded during test: | | | | | | | |
| List associated equipment included in test: | | | | | | | |
| Miscellaneous Information: | | | | | | | |

**Exhibit A**
**Test Data – Megohms**
**Test No. ____**

| | |
|---|---|
| Part Tested: | Test Performed: _____<br>Hours/Days: _____<br>After Shutdown: _____ |
| Grounding Time: | Dry Bulb Temperature: _____<br>Wet Bulb Temperature: _____ |
| Test Voltage: | Equipment Temperature: _____<br>How Obtained: _____<br>Relative Humidity: _____<br>Absolute Humidity: _____<br>Dew Point: _____ |

Megohmmeter: Serial Number: _____ Range: _____
Voltage: _____ Calibration Date: _____

| Test Connections | To Line<br>To Earth<br>To Ground | To Line<br>To Earth<br>To Ground | To Line<br>To Earth<br>To Ground | Test Connections | To Line<br>To Earth<br>To Ground | To Line<br>To Earth<br>To Ground | To Line<br>To Earth<br>To Ground |
|---|---|---|---|---|---|---|---|
| 1/4 Minute | | | | 5 Minutes | | | |
| 1/2 Minute | | | | 6 Minutes | | | |
| 3/4 Minute | | | | 7 Minutes | | | |
| 1 Minute | | | | 8 Minutes | | | |
| 2 Minutes | | | | 9 Minutes | | | |
| 3 Minutes | | | | 10 Minutes | | | |
| 4 Minutes | | | | 10/1 Minute Ratio | | | |

Remarks:

**END OF SECTION**

## SECTION 26 05 26
## GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install grounding systems complete in accordance with the requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.

B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.

C. In addition to the NEC requirements, building structural steel columns and metallic chemical storage tanks shall be permanently and effectively grounded:

D. Reference Section 26 05 00 – Basic Electrical Requirements

### 1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE)

    a. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

    b. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment

2. National Fire Protection Association (NFPA)

    a. NFPA 70 – National Electrical Code (NEC)

3. Underwriters Laboratories (UL)

    a. UL 467 – Grounding and Bonding Equipment

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## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings, including

a. Product data sheets

b. Drawings and written description of how the Contractor intends to furnish and install the grounding system

2. Reports of certified field tests.

B. Each submittal shall be identified by the applicable Specification Section.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

## 2.02 GROUND RODS AND GRID

A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467-Listed. The ground rods shall be manufactured by Erico Products, Blackburn, or Engineer approved equal.

B. Except where specifically indicated otherwise, all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways, and neutral conductors of wiring systems shall be grounded.

C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If

flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.

D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

## 2.03 FITTINGS

A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467-Listed.

## 2.04 EQUIPMENT GROUNDING CONDUCTORS

A. An insulated equipment grounding conductor, which shall be separate from the electrical system grounded (neutral) conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC-required equipment grounding conductor is not acceptable.

## 2.05 EQUIPMENT GROUNDS

A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds, and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

## 2.06 GROUND BARS

A. Ground bars shall be furnished and installed where indicated on the Drawings and where required in the Specifications. Ground bars shall be tin-plated copper, 1/4-inch-thick (minimum) with hole pairs spaced for NEMA 2-hole cable termination lugs. The number of hole pairs shall be as required for the number of cables terminated, plus four spares (minimum). Ground bars shall be provided with insulated mounting hardware.

## 2.07 EXOTHERMIC WELDS

A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.

2. The ground rods shall be interconnected by the use of copper cable sized as shown on the Drawings. The interconnecting cables shall be connected to ground rods by hydraulic crimp or exothermic weld where buried, and removable bolted clamp where shown to be installed in test wells. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside, and shall be connected to steel structures, equipment as described in this Section, and as required to provide a complete grounding system. The copper pigtails shall be hydraulically crimped or exothermically welded to the ground grid and connected to building reinforcement steel by hydraulic crimp.

3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.

5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

6. Buried hydraulic crimp connections, exothermic welds, and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, switchboards, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

a. None required.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

b. Fall of potential tests shall be performed on the ground grid per IEEE 81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

**END OF SECTION**

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## SECTION 26 05 29
## HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install structural supports for mounting and installing all conduits, electrical equipment, lighting, alarm systems, instrumentation, and control and communications equipment furnished under this Contract.

B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.

C. Support design for all nonstructural electrical components (e.g., conduit and other raceways, freestanding equipment, etc.) shall be provided in accordance with the governing Building Code and Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

D. Metal welds and fasteners shall be provided in accordance with the governing Building Code and Section 05 05 23 – Metal Fastening.

E. Reference the following Specification Sections:

1. Section 01 73 23 – Anchorage and Bracing of Nonstructural Components

2. Section 05 05 23 – Metal Fastening

3. Section 05 10 00 – Metal Materials

4. Section 26 05 00 – Basic Electrical Requirements.

### 1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American Society for Testing and Materials (ASTM)

a. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

101524

b. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

c. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

d. ASTM A276 – Standard Specification for Steel Bars and Shapes.

e. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts.

2. National Fire Protection Association (NFPA)

a. NFPA 70 – National Electrical Code (NEC).

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop drawings

2. Structural support calculations and designs in accordance with the governing Building Code and Section 01 73 23 – Anchorage and Bracing of Nonstructural Components.

B. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

### 2.02 MATERIALS

A. Support channel shall be 1-5/8” by 1-5/8” minimum, with 12-gauge material thickness.

B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Material of Construction |
|---|---|
| Indoor Wet Process Area | Type 316 Stainless Steel |
| Indoor Dry Process Area | Hot Dipped Galvanized Steel |
| Indoor Dry Non-process Area | Hot Dipped Galvanized Steel |
| Indoor Type 1 Chemical Storage/Transfer Area | Fiberglass |
| Indoor Type 2 Chemical Storage/Transfer Area | Type 316 Stainless Steel |
| All Outdoor Areas | Type 316 Stainless Steel |
| All Hazardous Areas | Type 316 Stainless Steel |

C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Material of Construction |
|---|---|
| Indoor Wet Process Area | Type 316 Stainless Steel |
| Indoor Dry Process Area | Type 316 Stainless Steel |
| Indoor Dry Non-process Area | Type 316 Stainless Steel |
| Indoor Type 1 Chemical Storage/Transfer Area | Fiberglass |
| Indoor Type 2 Chemical Storage/Transfer Area | Type 316 Stainless Steel |
| All Outdoor Areas | Type 316 Stainless Steel |
| All Hazardous Areas | Type 316 Stainless Steel |

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Concrete and Masonry Anchors

1. The Contractor shall be responsible for the furnishing and installation of all concrete anchors, masonry anchors, anchor screen tubes, bolts, and similar devices required for installation of equipment furnished under this Contract.

2. Where specific anchor types and sizes are called for on the Drawings, those anchor types and sizes shall be used. Where the Drawings call for anchors but do not have any type or size details shown, the anchors shall be designed and selected by an Engineer currently registered in the state of Georgia. Reference Section 05 05 23 – Metal Fastening for anchor product specifications and anchor design requirements.

B. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

C. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.

2. Unless otherwise indicated on the Drawings or in the Specifications, guards/handrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Guards/handrails shall not be cut, drilled, or otherwise modified in order to accommodate electrical supports without written approval from the Engineer.

3. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars, where possible, to facilitate removal of ceiling panels.

4. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.

5. Equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.

6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.

7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.

8. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.

9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, 9-mil polyethylene tape, or gaskets. Reference Section 05 10 00 – Metal Materials for guidance on dissimilar metals.

10. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a Professional Engineer currently licensed in the state of Georgia.

11. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a Professional Engineer currently licensed in the state of Georgia.

    a. A quantity of 12 or more conduits trade size 1-inch and smaller are proposed for a conduit support rack.

    b. A quantity of 8 or more conduits trade sizes 1-1/2- to 2-1/2-inch are proposed for a conduit support rack.

    c. A quantity of 4 or more conduits trade sizes 3-inch and larger are proposed for a conduit support rack.

12. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

D. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (e.g., brackets, mounting feet, bolt holes) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field-modified

by any means which compromises the UL Listing or NEMA rating of the enclosure/assembly.

**END OF SECTION**

## SECTION 26 05 33.13
## CONDUIT FOR ELECTRICAL SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install conduits, conduit fittings, and appurtenances to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.

B. Reference Specification Section 26 05 00 – Basic Electrical Requirements.

C. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Specification Section 26 05 29 – Hangers and Supports for Electrical Systems, for these requirements.

### 1.02 CODES AND STANDARDS

A. All equipment and materials shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Conduits, conduit fittings, and appurtenances shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)

    a. ANSI/ASME B1.20.1 – Pipe Threads, General Purpose

    b. ANSI C80.1 – Electrical Rigid Steel Conduit

    c. ANSI C80.3 – Steel Electrical Metallic Tubing

    d. ANSI C80.5 – Electrical Rigid Aluminum Conduit

    e. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

2. National Electrical Contractors Association (NECA)

    a. NECA 1 – Standard for Good Workmanship in Electrical Construction

3. National Electrical Manufacturer’s Association (NEMA)

    a. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings

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b. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit

c. NEMA RV-3 – Application and Installation Guidelines for Flexible and Liquid-tight Flexible Metal and Nonmetallic Conduits

d. NEMA TC-2 – Electrical PVC Conduit

e. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

4. National Fire Protection Association (NFPA)

a. NFPA 70 – National Electrical Code (NEC)

5. Underwriters Laboratories (UL)

a. UL 1 – Standard for Flexible Metal Conduit

b. UL 6 – Electrical Rigid Metal Conduit-Steel

c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel

d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit

e. UL 467 – Grounding and Bonding Equipment

f. UL 514B – Conduit, Tubing, and Cable Fittings

g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings

h. UL 797 – Electrical Metallic Tubing-Steel

i. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations

j. UL 1479 – Standard for Fire Tests of Penetration Fire Stops

k. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit

6. Others

a. American Concrete Institute (ACI): ACI 318 – Building Code Requirements for Structural Concrete

b. Aluminum Association – Aluminum and It’s Alloys

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Conduit identification methods and materials.

2. Product data sheets for conduits, fittings, and miscellaneous associated materials.

a. The product data sheets for conduits and fittings for up to three manufacturers for each type of conduit specified herein will be reviewed if they are submitted at the same time under the same submittal cover for simultaneous review.

b. Despite the number of manufacturers that may be approved, only one manufacturer of PVC coated rigid metal conduit will be permitted to be installed on this project in accordance with the requirements set forth in PART 3 herein.

3. Manufacturer’s Warranty Statement for PVC coated rigid metal conduit.

4. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

## 1.05 DEFINITIONS

A. Conduits are categorized by the circuit type of wiring to be installed inside. Conduits are defined as follows:

1. Power Conduits: Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.

2. Control Conduits: Conduits that carry AC or DC discrete control wiring between devices and/or equipment.

3. Instrumentation Conduits: Conduits that carry AC or DC analog signal wiring between devices and/or equipment. Also, conduits that carry fiber optic cables between devices and/or equipment. Conduits that carry Category 5e or Category 6 unshielded twisted-pair cables.

B. Conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:

1. P: Power Conduit

2. C: Control Conduit

3. I: Instrumentation Conduit

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses, and installation requirements of these conduits and conduit fittings.

B. All metallic conduit fittings shall be UL 514B and UL 467 Listed and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I, Division 1 hazardous areas shall be UL 1203 Listed with a visible certification tag on the outside of the fitting. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.

C. Flexible conduit couplings for use in Class I, Division 1 hazardous areas shall have threaded Type 316 stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of Type 316 stainless steel where available in the conduit trade size required for the application. Where Type 316 stainless steel braid is not available, the braid shall be provided with a factory-applied PVC coating. No other braid types or materials are acceptable.

D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.

E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.

F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to 3/4 inch of expansion/contraction along the axis of the conduit as well as up to 3/4 inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by Type 304 stainless steel clamps.

G. Conduit seals shall either be Listed and Labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.

H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.

I. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

## 2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I, Division 1 hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

3. Conduit bodies for all other areas shall be provided with covers that are affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of Type 316 stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

## 2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.

2. Conduit body shall be provided with cover that is affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs (threaded adapters) shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.

3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

## 2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.

2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

3. PVC coated conduit and associated PVC coated fittings shall be Ocal-Blue by ABB, Plasti-Bond by Robroy Industries, or Perma-Cote by Robroy Industries, no substitutions.

4. PVC coated conduit and associated PVC coated fittings shall be provided with a 5-year non-prorated warranty covering manufacturing defects and improper installation by the Contractor.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN 1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I, Division 1 hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by Type 304 stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

## 2.05 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.

2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed. Conduits shall be Listed for and marked with maximum temperature ratings as follows:

   a. 105 degrees C dry, 60 degrees C wet for all conduit installed against or within 2 inches of equipment capable of having a surface temperature of 80 degrees C or greater (e.g., blowers, incinerators, etc.)

   b. 80 degrees C dry, 60 degrees C wet for all other locations

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of one of the following:

   a. Type 316 stainless steel

   b. Copper-free aluminum

   c. Electro-galvanized malleable iron alloy which is coated on the exterior with a 40-mil (minimum) PVC jacket and coated on the interior with a 2-mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to the rigid conduit.

2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall have an integral external bonding lug where required to comply with Standard Detail E-26-0104. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

## 2.06 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed and be Type LFNC-B.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

## 2.07 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

## 2.08 ELECTRICAL METALLIC TUBING (EMT) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dipped galvanized on the inside and outside and made of cold-rolled steel tubing. Conduit shall be manufactured in accordance with C80.3 and shall be UL 797 Listed.

B. Conduit Bodies for use with EMT

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies shall be provided with galvanized sheet steel covers that are affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings for use with EMT

1. Couplings shall have threaded compression connectors with associated gland and shall be constructed of electro-galvanized steel. Fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable. Couplings shall be rain-tight.

D. Conduit Expansion and Deflection Fittings for use with EMT

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with EMT

1. Conduit termination fittings shall be constructed of electro-galvanized steel and have a plastic insulated throat. Termination fittings shall have a threaded compression connector with associated gland on one end and external threads on the other end. Termination fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts shall have integral bonding screw where required for proper bonding.

## 2.09 CONDUIT BENDS

A. Rigid conduit bends, both factory-fabricated and field-fabricated, shall meet the same requirements listed in the previous articles for the respective conduit type and material of construction.

B. Conduit bend radii for standard radius bends shall be no less than as follows:

| **Trade Size (inches)** | 3/4 | 1 | 1-1/4 | 1-1/2 | 2 | 2-1/2 | 3 | 3-1/2 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Min. Radius (inches)** | 4-1/2 | 5-3/4 | 7-1/4 | 8-1/4 | 9-1/2 | 10-1/2 | 13 | 15 | 16 | 24 | 30 |

C. Conduit bend radii for long radius bends shall be no less than as follows:

| **Trade Size (inches)** | 3/4 | 1 | 1-1/4 | 1-1/2 | 2 | 2-1/2 | 3 | 3-1/2 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Min. Radius (inches)** | N/A | 12 | 18 | 24 | 30 | 30 | 36 | 36 | 48 | 48 | 60 |

## 2.10 MISCELLANEOUS

A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:

a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.

b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors.

c. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

2. See PART 3 herein for the specific application of the previously specified conduit periphery sealing requirements that are to be used based on what the conduit will be penetrating.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. For all conduits that have cables inside, the sealing of the inside of the conduits against water ingress shall be achieved through the use of one of the following:

a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.

b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2-inch and larger.

c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two Type 304 stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.

2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not previously listed herein is not acceptable.

3. For conduits identified as spares, the sealing of the inside of the conduit against water ingress shall be achieved by using appropriately sized rubber expanding-style conduit plugs.

E. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, ½-inch wide, with a minimum tensile strength of 1250 lbs. In addition, pull ropes for conduits that are installed concealed shall also have a 22-AWG (minimum) tin-plated copper conductor woven in to make the rope detectable.

2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull and shall be made of a non-metallic material.

F. Innerduct

1. Provide a fabric type innerduct in conduits for installation of fiber optic cables where shown on the Drawings.

2. The innerduct shall be 4-cell.

3. The fabric innerduct shall be MaxCell Edge or approved equal.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. All conduit and associated fittings and appurtenances shall be installed in accordance with NECA 1.

B. Minimum trade size for all rigid conduits shall be 1-inch if any portion of the conduit is installed in a ductbank and 3/4-inch for all other applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2-inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.

C. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2-inch in all applications.

D. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.

E. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.

F. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.

G. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be ¾ inch per foot tapered threads in accordance with ANSI B1.20.1.

H. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.

I. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.

J. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:

| Installation Scenario | Clearance |
|---|---|
| Parallel to conduits with conductors energized at 480V or above | 18 inches |
| Parallel to conduits with conductors energized at 240V and below | 12 inches |
| At right angles to conductors energized at 480V and below | 6 inches |
| At right angles to conductors energized at voltages above 480V | 12 inches |

K. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.

L. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.

M. Conduits shall not penetrate the floors or walls inside liquid spill containment areas without specific written authorization from the Engineer. Liquid spill containment areas are indicated on the Drawings.

N. Conduits shall only penetrate the walls of liquid-holding tanks or basins above the maximum liquid elevation. Conduits shall not penetrate walls below this elevation. Maximum liquid elevations are indicated on the Drawings.

O. Conduits that terminate at roof mounted equipment shall be installed through the roof curb for the associated equipment to avoid additional roof penetrations wherever possible. Conduits that are installed horizontally on roof surfaces shall be supported by roof blocks that do not impact the roof manufacturer's warranty and shall be installed at least 7/8 inch above the roof surface to avoid the need to further de-rate the conductors inside.

P. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs. Spring steel fasteners may only be used to affix conduits containing lighting branch circuits within EMT conduits to structural steel members.

Q. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.

R. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.

S. If multiple manufacturers of PVC coated conduit and conduit fittings are reviewed and approved for use by the Engineer, only one manufacturer shall be permitted to be used on the project throughout the entirety of the project. Consistency of a single manufacturer is critical to ensure proper fit and alignment, and to maintain the manufacturer's warranty throughout the PVC coated system. Use of multiple manufacturers' PVC coated products is not acceptable.

T. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel in accordance with Standard Detail E-26-0102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.

U. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

## 3.02 CONCEALED AND EMBEDDED CONDUITS

A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:

1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.

2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail S-03-0403 and ACI 318.

3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible. The straight portion shall emerge perpendicular to the embedment (i.e., neatly oriented 90 degrees to floor/slab/grade). Conduits that emerge in a non-perpendicular orientation are not acceptable.

4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.

5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.

B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:

1. Conduits shall not be installed embedded within any water-bearing floors or walls.

2. Conduits shall not be installed embedded within any liquid containment area floors or walls.

3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division 1 and Division 2).

4. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

## 3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

**Rigid Conduit for Non-Hazardous Areas**

| | Conduit Category by Wiring / Circuit Type | |
|---|---|---|
| **Installation Area Designation / Scenario** | **Power and Control** | **Instrumentation** |
| Exposed in indoor wet process areas | PVC coated rigid galvanized steel conduit | Same as Power and Control |
| Exposed in indoor dry process areas | Rigid galvanized steel conduit | Same as Power and Control |
| Exposed in indoor dry non-process areas | Rigid galvanized steel conduit | Same as Power and Control |
| Exposed in indoor Type 1 chemical storage/transfer areas | Schedule 80 rigid non-metallic PVC conduit | Same as Power and Control |
| Exposed in indoor Type 2 chemical storage/transfer areas | PVC coated rigid galvanized steel conduit | Same as Power and Control |
| Exposed in outdoor areas | PVC coated rigid galvanized steel conduit | Same as Power and Control |
| Concealed within underground concrete-encased ductbanks | Schedule 40 rigid non-metallic PVC conduit | Rigid galvanized steel conduit |
| Direct-buried conduits (where specifically permitted) | Schedule 40 rigid non-metallic PVC conduit | Rigid galvanized steel conduit |
| Concealed within non-elevated (i.e., "slab-on-grade" construction) concrete slabs | Schedule 40 rigid non-metallic PVC conduit | Rigid galvanized steel conduit |
| Concealed within elevated concrete slabs | Rigid galvanized steel conduit | Rigid galvanized steel conduit |
| Concealed below concrete slabs (within earth or fill material) | Schedule 40 rigid non-metallic PVC conduit | Rigid galvanized steel conduit |
| Concealed within concrete walls | Schedule 40 rigid non-metallic PVC conduit | Rigid galvanized steel conduit |
| Concealed within CMU walls | Schedule 40 rigid non-metallic PVC conduit or Electrical Metallic Tubing | Rigid galvanized steel conduit or Electrical Metallic Tubing |

**Rigid Conduit for Non-Hazardous Areas**

| Installation Area Designation / Scenario | Conduit Category by Wiring / Circuit Type | |
|---|---|---|
| | Power and Control | Instrumentation |
| Concealed above suspended ceilings | Rigid galvanized steel conduit | Same as Power and Control |
| Concealed within interior walls constructed of metal studs and gypsum wall board | Electrical Metallic Tubing | Same as Power and Control |
| Emerging from concealment within or below a concrete floor and transitioning to exposed conduit (Reference Detail E-26-0102) | PVC coated rigid galvanized steel conduit | Same as Power and Control |

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

**Rigid Conduit for Hazardous Areas**

| Installation Area Hazard / Scenario | Conduit Category by Wiring / Circuit Type | |
|---|---|---|
| | Power and Control | Instrumentation |
| Exposed in Class I and II areas (Division 1 and Division 2) | PVC coated rigid galvanized steel conduit | Same as Power and Control |
| Concealed within concrete slabs in Class I and II areas (Division 1 and Division 2) | Rigid galvanized steel conduit | Same as Power and Control |
| Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division 1 and Division 2) | Rigid galvanized steel conduit | Same as Power and Control |
| Concealed within concrete walls in Class I and II areas (Division 1 and Division 2) | Rigid galvanized steel conduit | Same as Power and Control |
| Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I, Division 1 areas | Schedule 40 rigid non-metallic PVC conduit | Rigid galvanized steel conduit |
| Concealed above suspended ceilings in Class I and II areas (Division 1 and Division 2) | PVC coated rigid galvanized steel conduit | Same as Power and Control |

3. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the previous tables, with the following exceptions:

    a. All 90-degree bends or combinations of adjacent bends that form a 90-degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.

2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in PART 2 herein.

3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.

4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:

    a. All conduits containing medium voltage cable

    b. All conduits containing fiber optic cable

    c. All conduits containing shielded VFD cable

    d. Where specifically indicated on the Drawings

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:

    a. Connections to motors and engine-generator sets (and similar vibrating equipment)

    b. Connections to solenoid valves and limit switches

    c. Connections to lighting fixtures installed in suspended ceilings

d. Connections to lighting transformers and combination power units

e. Connections to pre-fabricated equipment skids

f. Connections to HVAC equipment

g. Connections to instrument transmitters and elements

h. Where specifically indicated in the Standard Details

2. Flexible conduit length shall be limited to 3 feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Unless otherwise specified herein, flexible conduits shall be installed in accordance with the Installation Guidelines published within NEMA RV-3.

4. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

**Flexible Conduit for Non-Hazardous Areas**

| | **Conduit Category by Wiring / Circuit Type** | |
|---|---|---|
| **Installation Area Designation / Scenario** | **Power and Control** | **Instrumentation** |
| Exposed in indoor wet process areas | Liquid-tight flexible metal conduit | Same as Power and Control |
| Exposed in indoor dry process areas | Flexible metal conduit | Same as Power and Control |
| Exposed in indoor dry non-process areas | Flexible metal conduit | Same as Power and Control |
| Exposed in indoor Type 1 chemical storage/transfer areas | Liquid-tight flexible non-metallic conduit | Same as Power and Control |
| Exposed in indoor Type 2 chemical storage/transfer areas | Liquid-tight flexible metal conduit | Same as Power and Control |
| Exposed in outdoor areas | Liquid-tight flexible metal conduit | Same as Power and Control |
| Concealed above suspended ceilings (all indoor areas) | Same material as exposed conduit in same area | Same as Power and Control |

5. For Class I, Division 1 hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all

other hazardous areas shall be furnished and installed in the materials of construction as follows:

**Flexible Conduit for Hazardous Areas**

| | Conduit Category by Wiring / Circuit Type | |
|---|---|---|
| **Installation Area Hazard / Scenario** | **Power and Control** | **Instrumentation** |
| Exposed in Class I, Division 2 areas | Liquid-tight flexible metal conduit | Same as Power and Control |
| Exposed in Class II (Division 1 and Division 2) areas | Liquid-tight flexible metal conduit | Same as Power and Control |
| Concealed above suspended ceilings in Class I (Division 2) and Class II (Division 1 and Division 2) areas | Same material as exposed conduit in same area | Same as Power and Control |

## 3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.

2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.

2. Where conduit bodies larger than trade size 2-inch are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.

2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

3. Unless otherwise specified herein, conduit expansion and deflection fittings shall be installed in accordance with the Installation Guidelines published within NEMA FB 2.40.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:

   a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.

   b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.

2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the interior locknut.

3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

## 3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. Unless otherwise indicated on the Drawings, below-grade conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in PART 2 herein.

2. Unless otherwise indicated on the Drawings, all conduit penetrations through interior walls and floors and above-grade exterior walls shall be sealed using conduit sleeves and caulk as specified in PART 2 herein. Alternatively, where concrete or masonry walls/floors are penetrated, mortar may be used to seal around the conduit periphery for conduit penetrations through interior walls and floors and above-grade exterior walls.

3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in PART 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

2. Conduit interior sealing shall not be installed until conductors inside are tested and test results are deemed acceptable by the Engineer. Conduit interior sealing shall be installed prior to energization of the conductors inside.

## 3.06 CONDUIT IDENTIFICATION

A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:

1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word “TO:” and the text in the ‘TO’ column of the conduit and wire schedule (e.g., TO: Plant Water Pump No. 1). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word “FROM:” and the text in the ‘FROM’ column of the conduit and wire

schedule (e.g., FROM: MCC-26). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.

3. For conduits trade sizes 3/4-inch through 1-1/2-inch, the text shall be a minimum 18-point font. For conduits trade size 2-inch and larger, the text shall be a minimum 24-point font.

4. Label height shall be 3/4-inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.

5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system using thermal transfer technology. Handwritten labels are not acceptable.

6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.

B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:

1. The tag shall be made of white Tyvek material, and have an orange label with black text, as previously described herein, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.

C. Conduits for lighting and receptacle circuits shall not require identification.

D. Any problems or conflicts with meeting the previously specified requirements shall immediately be brought to the attention of the Engineer for a decision.

## 3.07 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

## 3.08 TRAINING OF INSTALLATION PERSONNEL

A. All Contractor personnel that install PVC coated rigid metal conduit shall be trained by the PVC coated conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit or shall be trained/re-trained as required prior to commencement of conduit installation.

**END OF SECTION**

## SECTION 26 05 33.16
## BOXES FOR ELECTRICAL SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all pull boxes, junction boxes, and outlet boxes as specified herein, indicated on the Drawings, and as required. Requirements for other boxes and enclosures are not necessarily included in this Section. Reference each specific equipment Specification Section for requirements related to that equipment's respective enclosure.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 33.13 – Conduit for Electrical Systems

3. Section 26 05 53 – Identification for Electrical Systems

4. Section 26 27 26 – Wiring Devices

### 1.02 CODES AND STANDARDS

A. All boxes shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Boxes shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Electrical Manufacturers Association (NEMA)

   a. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

2. National Fire Protection Association (NFPA)

   a. NFPA 70 – National Electrical Code (NEC)

3. Underwriters Laboratories (UL)

   a. UL 50 – Enclosures for Electrical Equipment, Non-Environmental Considerations

   b. UL 50E – Enclosures for Electrical Equipment, Environmental Considerations

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c. UL 514A – Metallic Outlet Boxes

d. UL 514C – Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

e. UL 1203 – ExplosionProof and Dust-IgnitionProof Electrical Equipment for Use in Hazardous (Classified) Locations

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for boxes, terminal strips, and all accessories

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

## 1.06 IDENTIFICATION

A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g., PPB-26-01, CJB-26-01) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

### 2.02 PULL AND JUNCTION BOXES

A. General

1. All pull and junction boxes shall be UL Listed and Labeled.

2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.

3. Pull and junction boxes mounted embedded in concrete shall be UL Listed for embedment.

4. Where metallic boxes are used, they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. Metallic pull boxes in non-hazardous locations and in hazardous locations where general-purpose enclosures are permitted (e.g., Class I, Division 2 locations) shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.

2. Metallic pull boxes in hazardous locations where general-purpose enclosures are not permitted (e.g., Class I, Division 1 locations) shall be provided with a matching gasketed cover. Cover shall be hinged and held in place by stainless steel bolts. Hinge pins shall be removable. Covers shall be installed and bolts torqued in accordance with manufacturer requirements to maintain the hazardous location rating of the enclosure.

3. Non-metallic pull boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g., “flip”) latches. Latch material of construction shall match the box material, and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point

latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.

4. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.

5. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.

6. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

C. Junction Boxes

1. Metallic junction boxes in non-hazardous locations shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.

2. Metallic junction boxes in hazardous locations shall be provided with a matching gasketed cover. Cover shall be hinged and held in place by stainless steel bolts. Hinge pins shall be removable. Covers shall be installed and bolts torqued in accordance with manufacturer requirements to maintain the hazardous location rating of the enclosure.

3. Non-metallic junction boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g., “flip”) latches. Latch material of construction shall match the box material and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point

latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.

4. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

5. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.

6. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting of the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.

7. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Wet Process Area | NEMA 4X, Type 316 Stainless Steel |
| Indoor Dry Process Area | NEMA 12, Painted Steel |
| Indoor Dry Non-Process Area | NEMA 1, Painted Steel |
| Indoor Type 1 Chemical Storage/Transfer Area | NEMA 4X, Fiberglass or PVC |
| Indoor Type 2 Chemical Storage/Transfer Area | NEMA 4X, Type 316 Stainless Steel |
| All Outdoor Areas | NEMA 4X, Type 316 Stainless Steel |

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

| Area Classification | Enclosure Type and Material |
|---|---|
| Class I, Division 1, Group D | NEMA 7, Die Cast Aluminum |
| Class I, Division 2, Group D | NEMA 4X, Type 316 Stainless Steel |
| Class II, Division 1, Group F | NEMA 9, Die Cast Aluminum |
| Class II, Division 2, Group F | NEMA 4X, Type 316 Stainless Steel |

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

4. Where located outdoors or in indoor wet process areas, NEMA 7 and NEMA 9 enclosures shall also carry a NEMA 4X rating.

## 2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 26 27 26 – Wiring Devices for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep, and be provided with a ground screw inside.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.

3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Wet Process Area | NEMA 4X, PVC Coated Steel |
| Indoor Dry Process Area | NEMA 1, Cast Aluminum |
| Indoor Dry Non-process Area | NEMA 1, Cast Aluminum |
| Indoor Type 1 Chemical Storage/Transfer Area | NEMA 4X, PVC |
| Indoor Type 2 Chemical Storage/Transfer Area | NEMA 4X, PVC Coated Steel |
| All Outdoor Areas | NEMA 4X, PVC Coated Steel |

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

| Area Classification | Enclosure Type and Material |
|---|---|
| Class I, Division 1, Group D | NEMA 7, Die Cast Aluminum |
| Class I, Division 2, Group D | NEMA 4X, PVC Coated Steel |
| Class II, Division 1, Group F | NEMA 9, Die Cast Aluminum |
| Class II, Division 2, Group F | NEMA 4X, PVC Coated Steel |

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

6. Outlet boxes for NEMA 4X applications shall be furnished with integral external mounting lugs that are accessible from outside the box.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL Listed and Labeled. Pre-punched single diameter conduit

knockouts are acceptable; however, concentric and eccentric knockouts are not acceptable.

2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.

3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.

4. Outlet boxes mounted cast into concrete shall be concrete tight and made of galvanized steel or PVC.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.

4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 26 05 33.13 – Conduit for Electrical Systems for conduit hub requirements.

5. Pull and junction boxes may be installed flush mounted in gypsum, concrete, or CMU walls where appropriate provided that covers are easily removed or opened.

6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits. Boxes with integral external mounting lugs shall be attached with the lugs and shall not be drilled.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.

4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.

5. Depending on the type of wiring device to be installed in the outlet box, mounting heights from the finished floor or finished grade (as applicable) to the center of the box shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the ADA:

    a. Light switches: 48 inches

    b. Receptacles in indoor dry process/non-process areas: 18 inches

    c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas: 42 inches in open areas or 6 inches (minimum) above adjacent surfaces (e.g., countertops, tables, etc.) where applicable

    d. Receptacles in outdoor locations: 26 inches

    e. Flush mounted outlet boxes in CMU walls shall be adjusted to a slightly greater height than previously required herein to align the center of the box with the center of the CMU block.

6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

**END OF SECTION**

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## SECTION 26 05 53
## IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All electrical equipment shall be identified in the manner described, or in an equally approved manner.

B. The types of electrical identification specified in this Section include, but are not limited to, the following:

1. Operational instructions and warnings

2. Danger signs

3. Equipment/system identification signs

4. Nameplates

### 1.02 SIGNS

A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

### 1.03 LETTERING AND GRAPHICS

A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified, or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

### 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings, including product data sheets.

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## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The material covered by this Section is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

### 2.02 NAMEPLATES

A. Nameplates shall be engraved, high pressure plastic laminate, white foreground with black lettering.

B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or Engineer approved equal.

### 2.03 HIGH VOLTAGE SIGNS

A. Standard "DANGER" signs shall be of baked enamel finish on 20-gauge steel; of standard red, black, and white graphics; 14- x 10-inch size except where 10- x 7-inch is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

### 2.04 CONDUIT IDENTIFICATION

A. Conduit identification shall be as specified in Section 26 05 33.13 – Conduit for Electrical Systems.

### 2.05 WIRE AND CABLE IDENTIFICATION

A. Field installed wire and cable identification shall be as specified in Section 26 05 19 – Low-Voltage Conductors and Cable.

B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e., Phase A=Brown, Phase B=Orange, Phase C=Yellow).

C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective Section.

## 2.06 BOX IDENTIFICATION

A. Pull, junction and device box identification shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

# PART 3 – EXECUTION

## 3.01 NAMEPLATES

A. Nameplates shall be attached to the equipment enclosures with two stainless steel sheet metal screws for nameplates up to 2 inches wide. For nameplates over 2 inches wide, four stainless steel sheet metal screws shall be used, one in each corner of the nameplate. The utilization of adhesives is not permitted.

## 3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

## 3.03 POWER SOURCE IDENTIFICATION

A. After installation of all field equipment (e.g., valves, motors, fans, unit heaters, instruments) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (e.g., MCC number, panelboard), circuit number, conduit number from schedule and voltage/phase.

B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.

C. Nameplates shall be as specified herein.

**END OF SECTION**

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## SECTION 26 05 60
## LOW-VOLTAGE ELECTRIC MOTORS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all low-voltage electric motors as shown on the Drawings and specified herein. All motors required for this Contract shall comply with this Section unless otherwise noted.

### 1.02 CODES AND STANDARDS

A. Motors and related accessories shall be designed, manufactured, and/or listed to the following standards as applicable:

1. IEEE

    a. IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators

2. NEMA

    a. NEMA MG 1 – Motors and Generators

3. UL

    a. UL 547 – Standard for Safety Thermal Protectors for Motors

    b. UL 674 – Electric Motors and Generators for Use in Hazardous (Classified) Locations

    c. UL 1004-1 – Standard for Rotating Electrical Machines

    d. UL 1004-3 – Standard for Thermally Protected Motors

    e. UL 1004-8 – Standard for Inverter Duty Motors

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

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1. Shop Drawings

2. Spare Parts List

## 1.04 SHOP DRAWINGS

A. Individual shop drawings for electric motors shall be submitted in accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, unless submitted as a part of the shop drawings for the driven equipment.

B. Shop drawings for electric motors shall include motor data sheets, dimensioned drawings, wiring diagrams for devices such as space heaters, temperature devices, and shaft grounding rings. Shop drawings shall identify electric characteristics and design, mechanical construction, manufacturer's name, type and pertinent specifications for the use intended, along with the name of the equipment to be driven. For motors rated 50 horsepower or greater, submittal of motor data for acceptance shall include, at a minimum, the following:

1. Manufacturer's type and frame designation
2. Horsepower rating
3. Time rating (per NEMA Standards)
4. Ambient temperature rating
5. Motor winding insulation system designation
6. RPM at rated load
7. Frequency
8. Number of phases
9. Rated-load amperes
10. Voltage
11. Code letter (starting KVA per horsepower)
12. Design letter for integral horsepower induction motors (per NEMA Standards)
13. Service factor
14. Temperature rise at full load and at service factor load
15. Efficiency at 1/4, 1/2, 3/4 and full load

16. Power factor at 1/4, 1/2, 3/4 and full load

17. Motor outline, dimensions and weight

18. Motor winding insulation system description

19. Horsepower required by connected machine at specified conditions (load curves) shall be supplied for all compressors, propeller and positive displacement pumps.

20. The foregoing data shall also be verified after manufacture and shall be included with the information to be furnished in the operation and maintenance manuals specified.

C. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## 1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment covered by this Section is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Electric motors shall be manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or equal.

## 2.02 MATERIALS AND CONSTRUCTION

A. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, ANSI and to the requirements specified herein.

B. Type

1. Unless otherwise noted, motors specified herein shall be polyphase squirrel cage, NEMA Design B, or single phase capacitor or repulsion start induction motors.

Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.

2. Unless otherwise shown or specified, all motors 1/2 horsepower or larger shall be three- phase, 60 Hertz, NEMA Design B, squirrel cage induction motors designed for operation at 480 volts or greater as specified herein or shown on the Drawings.

3. Unless otherwise specified in the individual equipment Specification Section for the driven equipment, or as required by the dynamic characteristics of the load as determined by the manufacturer of the machine to be driven, all polyphase squirrel cage motors shall be designed to withstand the starting voltage shown on the Drawings and shall have torque and locked rotor current characteristics as specified for NEMA Design B motors.

4. All motors 2 horsepower and smaller shall have windings encapsulated with a flexible epoxy compound, or insulated with a flexible epoxy compound, or insulated with the manufacturer's premium quality system which shall be subject to acceptance by the Engineer.

5. All motors above 250 horsepower shall have stator windings vacuum impregnated with a polyester insulation compound.

6. Unless otherwise noted, all motors smaller than 1/2 horsepower shall be standard single-phase capacitor start or repulsion start induction type designed for operation on 120 volts or 208 volts, 60 Hz alternating current. The motor shall deliver rated load without exceeding a 80 degrees C temperature rise while operating in a 40 degrees C ambient temperature. Small fan motors less than 1/4 HP may be split-phase or shaded pole type. Shaded pole motors rated more than 1/4 horsepower are not acceptable. Fractional horsepower motors shall be completely equipped with all necessary auxiliary components for starting and labeled as "Thermally Protected". Insulation shall be Class B, except that submersible motors shall have epoxy encapsulation. Unless otherwise noted, the motors shall be totally enclosed. Small fan motors may be of the open type where they are suitably protected from moisture dripping and lint accumulation. Motors shall be provided with sealed ball bearings lubricated for 10 years of normal use.

7. Where specified, vertical hollowshaft motors shall be designed to carry the motors', pumps', and associated equipment's full thrust. The motors shall be equipped with grease lubricated spherical roller thrust bearings and lower radial guide bearings. Vertical hollowshaft motors shall be fitted with nonreversing ratchet assemblies where required by equipment specifications. Vertical adjustment shall be provided by means of a lockable nut at the top of the shaft.

8. Vertical hollowshaft motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads. Horizontal motors shall not be installed where subjected to external thrust loads.

C. Rating

1. Each motor shall develop ample torque for its required service through its acceleration range and throughout its rated load range. The rating of the motors offered shall in no case be less than the horsepower shown on the Drawings or elsewhere specified. It should be noted that the motor sizes indicated on the Drawings or as otherwise specified herein, are motor sizes required to operate the specific equipment which is specified. Higher rated motor sizes may be determined from the actual equipment submitted, approved, purchased, and installed. Protective devices, motor starters, disconnect switches, and other necessary equipment shall be furnished and installed for the actual motor sizes required at no additional cost.

2. Motor ratings shall be based on continuous operation. The maximum temperature rise for open and drip proof type motors shall not exceed 90 degrees C, and for totally enclosed type motors shall not exceed 80 degrees C.

D. Motor Winding Insulation

1. Insulation shall be as specified for each particular type or class of motor. The insulation system shall provide a high dielectric strength, long life covering for the windings which may be required to operate in a continually damp, corrosive, and/or chemically contaminated environment. The insulation shall be resistant to attack by moisture, acids, alkalies, abrasives, and mechanical and thermal shock. Leads shall be sealed with a non-wicking, non-hydroscopic insulation material.

2. Motor insulation resistance may be checked at any time after delivery to the job site or during the warranty period. Encapsulated motor stators may be subjected to insulation testing while completely submerged in water. Any motor not meeting the requirements specified herein will be rejected and shall be promptly replaced at no cost to the Owner.

3. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design B. The locked rotor KVA/HP input at full voltage for 10 horsepower. motors and larger shall not exceed that permitted for Code Letter "J", except for specialized equipment requiring a motor drive with special definite characteristics.

4. Unless otherwise specified, non-inverter duty motors shall be furnished with a Class F insulation system. Unless otherwise specified, inverter duty motors shall be furnished with a Class H insulation system. In either case, temperature rise shall be limited to that for Class B insulation. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment through the full range of acceleration and operating load conditions without exceeding the nameplate current rating, and/or temperature rise.

E. Nameplates

1. The motor manufacturer's nameplate shall be engraved, embossed, or stamped on a stainless steel sheet and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Printed or laser-etched nameplates are not acceptable.

2. Nameplates shall include as a minimum, Items 1 through 14 as listed in Article 1.04, Paragraph D herein in addition to that required by NEMA standards. The nameplate shall be positioned so as to be readily visible for inspection as installed in the facility.

F. Design

1. Motors shall be designed to accelerate and drive the connected equipment under all normal operating conditions without exceeding nameplate ratings.

2. Motors specified for operation with variable frequency drives shall be inverter duty rated. Motors shall be considered inverter duty rated only if they meet all of the requirements for NEMA MG-1 Part 31.

3. Motors shall be designed to output 100 percent of nameplate horsepower under continuous duty service without exceeding the temperature rise specified herein when controlled by the actual drives furnished. Inverter duty motors shall be designed to operate down to 10% of full load speed without the need for a line powered cooling fan.

4. Unless otherwise specified, electric motors shall be furnished with service factors in accordance with NEMA MG-1 as follows:

| Type of Motor | Service Factor |
|---|---|
| Non-inverter Duty | 1.15 |
| Inverter Duty | 1.0 |

5. Design selection with respect to the driven machine shall be such that the requirements do not exceed 85 percent of the motors' maximum rating modified by service factor, ambient temperature, enclosure, altitude and electrical service. The electrical service conditions shall be assumed to be 10 percent undervoltage, 5 percent underfrequency, and 3 percent voltage unbalance. Altitude shall be assumed to be the project site elevation plus 10 percent. Ambient temperature shall be assumed to be 95 degrees F in exterior locations, 104 degrees F (40 degrees C) in interior locations, and 122 degrees F (50 degrees C) within housings or enclosures; except where higher temperatures may be encountered within or on

individual items of equipment. The applicable paragraphs of NEMA MG-1 shall be used in making the design selection.

6. Motors used with belt drives shall have sliding bases to provide for belt take up.

7. Terminal boxes shall be of sufficient size to accommodate the required quantity and size of conduits. Gasketed terminal boxes shall be furnished with all splash-proof and totally enclosed motors. NEMA ratings of the terminal boxes shall be suited for the application. Motors located in hazardous locations shall be furnished with terminal boxes suitable for the specific Class, Division, and Group suitable for the application. Terminal boxes shall be sized to accommodate accessory equipment such as motor differential current transformers, where required.

8. Terminal boxes for horizontal motors shall be located on the left-hand side when viewing the motor from the drive shaft end and shall be so designed that conduit entrance can be made from above, below, or either side of the terminal box.

9. Motors larger than 250hp shall be manufactured with the six stator coil leads wired to a suitably sized motor junction box for application in a differential relay scheme. Current transformers shall be provided by the motor manufacturer and installed in the factory. All ground connections and current transformer connections shall be made in the factory.

G. Construction

1. Frames, mounting means, and shafts shall meet NEMA Standards for the horsepower, RPM, and enclosure selected. Enclosures shall be selected according to the degree of mechanical protection required and shall not be of aluminum construction. All motors shall have a manufacturer's standard shop machinery finish, consisting of a rust-resisting priming coat of zinc chromate and a finish coat of alkyd machinery enamel. Reference Section 09 90 00 – Painting.

2. Motors shall have cast iron frames and a heavy gauge steel terminal box, with neoprene gaskets between the frame and the box and between the box and its cover. A grounding lug(s) shall be provided inside the terminal box.

3. Motors weighing more than 50 pounds shall be equipped with at least one lifting eye. All lifting hardware shall be corrosion resistant.

4. Motors located in hazardous locations shall be totally enclosed and suitable for the specific Class, Division, and Group suitable for the application.

5. Motors located in Class I or II, Division 1 hazardous locations shall bear a U.L.-674 label and shall be provided with a breather/drain approved for the hazardous

location. The U.L. listed breather/drain shall prevent the entrance of contaminants while allowing moisture to drain out of the motor.

6. When located outdoors, or elsewhere if specified, motors shall be totally enclosed, non-ventilated (TENV) or totally enclosed, fan-cooled (TEFC) machines, unless otherwise noted. Totally enclosed motors shall be provided with two (2) 1/4 inch drain holes drilled through the bottom of the frame, which allows complete drainage of the frame. Where specified, TEFC motors controlled by a variable frequency drive shall be provided with a separately powered cooling fan motor that runs at 60HZ to ensure proper cooling of the motor at low speeds. Cooling fan motor shall be suitable for 120VAC, single phase operation. Vertically oriented motors located outdoors shall be provided with a drip cover over the fan end to prevent accumulation of precipitation.

7. Unless otherwise specified, motors rated 40 horsepower or greater located outdoors, in unheated structures, in below grade areas, or as otherwise indicated, shall be furnished with space heaters and embedded motor winding high temperature switches with leads brought out of the motor terminal box. Space heaters shall be suitable for 120VAC operation and for a maximum surface temperature of less than 200 degrees C. Space heaters shall be of sufficient wattage to maintain the internal temperature of the motor at approximately 10 degrees C above the ambient temperature when the motor is not running.

    a. Embedded motor winding temperature switches shall operate at temperatures well below the temperature rating of the motor winding insulation system. Motor winding temperature switches are not required where other temperature monitoring devices (e.g. RTD's) are required.

8. Unless otherwise specified in the equipment Specification Sections, motors rated 200HP or greater that are controlled by a VFD shall be furnished with resistance thermal detectors (RTD’s) embedded in the stator windings, two per phase. RTD’s shall be pre-wired to terminal blocks located in a separate terminal box as specified herein.

9. Unless otherwise specified in the equipment Specification Sections, motors rated less than 200HP that are controlled by a VFD shall be furnished with motor winding high temperature switches embedded in the stator windings with the leads brought out to the motor terminal box.

10. If so specified and when located in indoor areas which are heated and weatherproof, motors shall be open drip-proof machines. Ventilation openings shall be arranged to prevent the entrance of drops of liquid or solid particles at any angle from zero to 15 degrees downward from vertical.

11. Unless otherwise specified, or required, motors rated less than 200 horsepower shall be furnished with bearings of the grease lubricated, antifriction ball type with

conveniently located grease fittings and drain plugs. A means of preventing bearings from becoming over-greased shall be provided. Bearings shall have a minimum ABMA L10 life of 20,000 hours.

12. Rotors shall be statically and dynamically balanced. Rotor windings shall be one-piece cast aluminum. Where applicable, rotors shall be constructed with integral fins.

13. Externally mounted motor shaft grounding rings shall be provided to protect motors against motor shaft and bearing currents. Grounding rings shall be provided for all motors controlled by VFDs, with the following exceptions:

    a. Motors located in hazardous areas

    b. Motors rated less than 1 horsepower

    c. Submersible motors

14. All motors shall be provided with factory-installed one-hole terminations (ring terminals) on the ends of all motor leads. Terminations shall be identified for use with cables that have stranding other than Class B and shall be the irreversible compression type.

H. Power Factor and Efficiency

1. All motors, including vertical hollowshaft motors, in the range of 1 through 500 horsepower, inclusive, shall be designed specifically for energy efficiency and high power factor. The motor efficiency and power factor shall meet or exceed the values listed in the following table when the motors are tested in accordance with the NEMA preferred test method IEEE 112A, Method B, Dynamometer. Each motor shall meet the minimum guaranteed efficiency value indicated in the table below. All tests shall be performed in accordance with the procedures contained in NEMA Standard MG1-12.58.

**Table 12-11**
**FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS**
**ENCLOSED MOTORS**

| HP | 2 POLE | | 4 POLE | | 6 POLE | | 8 POLE | |
|---|---|---|---|---|---|---|---|---|
| | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency |
| 1 | 75.5 | 72 | 82.5 | 80 | 80 | 77 | 74 | 70 |
| 1.5 | 82.5 | 80 | 84 | 81.5 | 85.5 | 82.5 | 77 | 74 |
| 2 | 84 | 81.5 | 84 | 81.5 | 86.5 | 84 | 82.5 | 80 |
| 3 | 85.5 | 82.5 | 87.5 | 85.5 | 87.5 | 85.5 | 84 | 81.5 |

**Table 12-11**
**FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS**
**ENCLOSED MOTORS**

| HP | 2 POLE | | 4 POLE | | 6 POLE | | 8 POLE | |
|---|---|---|---|---|---|---|---|---|
| | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency |
| 5 | 87.5 | 85.5 | 87.5 | 85.5 | 87.5 | 85.5 | 85.5 | 82.5 |
| 7.5 | 88.5 | 86.5 | 89.5 | 87.5 | 89.5 | 87.5 | 85.5 | 82.5 |
| 10 | 89.5 | 87.5 | 89.5 | 87.5 | 89.5 | 87.5 | 88.5 | 86.5 |
| 15 | 90.2 | 88.5 | 91 | 89.5 | 90.2 | 88.5 | 88.5 | 86.5 |
| 20 | 90.2 | 88.5 | 91 | 89.5 | 90.2 | 88.5 | 89.5 | 87.5 |
| 25 | 91 | 89.5 | 92.4 | 91 | 91.7 | 90.2 | 89.5 | 87.5 |
| 30 | 91 | 89.5 | 92.4 | 91 | 91.7 | 90.2 | 91 | 89.5 |
| 40 | 91.7 | 90.2 | 93 | 91.7 | 93 | 91.7 | 91 | 89.5 |
| 50 | 92.4 | 91 | 93 | 91.7 | 93 | 91.7 | 91.7 | 90.2 |
| 60 | 93 | 91.7 | 93.6 | 92.4 | 93.6 | 92.4 | 91.7 | 90.2 |
| 75 | 93 | 91.7 | 94.1 | 93 | 93.6 | 92.4 | 93 | 91.7 |
| 100 | 93.6 | 92.4 | 94.5 | 93.6 | 94.1 | 93 | 93 | 91.7 |
| 125 | 94.5 | 93.6 | 94.5 | 93.6 | 94.1 | 93 | 93.6 | 92.4 |
| 150 | 94.5 | 93.6 | 95 | 94.1 | 95 | 94.1 | 93.6 | 92.4 |
| 200 | 95 | 94.1 | 95 | 94.1 | 95 | 94.1 | 94.1 | 93 |
| 250 | 95.4 | 94.5 | 95 | 94.1 | 95 | 94.1 | 94.5 | 93.6 |
| 300 | 95.4 | 94.5 | 95.4 | 94s.5 | 95 | 94.1 | | |
| 350 | 95.4 | 94.5 | 95.4 | 94.5 | 95 | 94.1 | | |
| 400 | 95.4 | 94.5 | 95.4 | 94.5 | | | | |
| 450 | 95.4 | 94.5 | 95.4 | 94.5 | | | | |
| 500 | 95.4 | 94.5 | 95.8 | 95 | | | | |

**Table 12-12**
**FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS**
**RATED 600 VOLTS OR LESS (RANDOM WOUND)**
**OPEN MOTORS**

| HP | 2 POLE | | 4 POLE | | 6 POLE | |
|---|---|---|---|---|---|---|
| | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency |
| 1 | 77 | 74 | 85.5 | 82.5 | 82.5 | 80 |
| 1.5 | 84 | 81.5 | 86.5 | 84 | 86.5 | 81.5 |
| 2 | 85.5 | 82.5 | 86.5 | 84 | 87.5 | 81.5 |
| 3 | 85.5 | 82.5 | 89.5 | 84 | 88.5 | 86.5 |

**Table 12-12**
**FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS**
**RATED 600 VOLTS OR LESS (RANDOM WOUND)**
**OPEN MOTORS**

| HP | 2 POLE | | 4 POLE | | 6 POLE | |
|---|---|---|---|---|---|---|
| | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency | Nominal Efficiency | Minimum Efficiency |
| 5 | 86.5 | 84 | 89.5 | 84 | 89.5 | 87.5 |
| 7.5 | 88.5 | 86.5 | 91 | 89.5 | 90.2 | 88.5 |
| 10 | 89.5 | 87.5 | 91.7 | 90.2 | 91.7 | 90.2 |
| 15 | 90.2 | 88.5 | 93 | 91.7 | 91.7 | 90.2 |
| 20 | 91 | 89.5 | 93 | 91.7 | 92.4 | 91 |
| 25 | 91.7 | 90.2 | 93.6 | 92.4 | 93 | 91.7 |
| 30 | 91.7 | 90.2 | 94.1 | 93 | 93.6 | 92.4 |
| 40 | 92.4 | 91 | 94.1 | 93 | 94.1 | 93 |
| 50 | 93 | 91.7 | 94.5 | 93.6 | 94.1 | 93 |
| 60 | 93.6 | 92.4 | 95 | 94.1 | 94.5 | 93.6 |
| 75 | 93.6 | 92.4 | 95 | 94.1 | 94.5 | 93.6 |
| 100 | 93.6 | 92.4 | 95.4 | 94.5 | 95 | 94.1 |
| 125 | 94.1 | 93 | 95.4 | 94.5 | 95 | 94.1 |
| 150 | 94.1 | 93 | 95.8 | 95 | 95.4 | 94.5 |
| 200 | 95 | 94.1 | 95.8 | 95 | 95.4 | 94.5 |
| 250 | 95 | 94.1 | 95.8 | 95 | 95.4 | 94.5 |
| 300 | 95.4 | 94.5 | 95.8 | 95 | 95.4 | 94.5 |
| 350 | 95.4 | 94.5 | 95.8 | 95 | 95.4 | 94.5 |
| 400 | 95.8 | 95 | 95.8 | 95 | 95.8 | 95 |
| 450 | 95.8 | 95 | 96.2 | 95.4 | 96.2 | 95.4 |
| 500 | 95.8 | 95 | 96.2 | 95.4 | 96.2 | 95.4 |

NOTES:

(Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.

(TEFC efficiencies apply to both horizontal and vertical motors.

2. Motors rated 50 horsepower or greater shall be individually tested at the factory before shipment, with a copy of test results provided for the Engineer, to assure compliance with the efficiency and power factor specifications.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Motors shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

### 3.02 DELIVERY, STORAGE, AND HANDLING

A. Motors shall be properly protected from weather hazards. Motors shall not be allowed to be wrapped tightly in plastic while outdoors. Motors delivered to the site which will not be put in service for a time in excess of 30 calendar days, whether in storage or installed, shall have the shafts rotated a minimum of five (5) rotations every 30 days.

B. Motors provided with space heaters shall have temporary power applied to the heaters no later than 30 calendar days after delivery to the site until permanent power can be applied to the heaters.

C. Motors that, in the opinion of the Engineer, have not been properly protected shall be inspected by the manufacturer's representative. Any required electrical corrections for testing shall be made at the Contractor's expense prior to acceptance and/or use.

D. All motors shall operate without any undue noise or vibration and shall show no signs of phase unbalance.

### 3.03 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

a. All motors shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. Shop tests for motors 100 horsepower and larger may be witnessed by the Engineer. The manufacturer's testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified, all other applicable requirements, and shall be approved by the Engineer. At least 10 days' notice shall be given the Engineer prior to tests and inspection dates.

b. In addition to the efficiency and power factor testing specified herein, each motor shall be tested to determine compliance with the applicable requirements of the IEEE, ANSI and NEMA. Tests shall be as follows:

1) Motors less than 50 HP:

a) Each motor shall be subjected to a standard, short commercial test including the following:

i. Running current, no load

ii. Locked rotor current

iii. High potential

iv. Winding resistance

v. Bearing inspection

2) Motors between 50 and 100 HP

a) Each motor shall be subjected to the above tests and shall be furnished with certified test results.

3) Motors larger than 100 HP

a) Each motor shall be furnished with certified test results. Each motor shall be subjected to a complete test consisting of full load heat run, percent slip, running load current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, secondary current and voltage at collector rings (wound rotor), efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load and bearing inspection. Tests will be witnessed by the Engineer where specifically indicated.

4) Test Reports

a) All test results for motors over 100 horsepower shall be submitted to the Engineer for approval. Copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

2. Field Tests

a. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 01, and Section 26 05 00 – Basic Electrical Requirements.

b. All electric motors furnished for this project one (1) horsepower or larger shall have the information required in the following tabulation completed. See Exhibit "A" on following page.

c. All field testing shall be witnessed by the Engineer.

**(EXHIBIT A)**

| MOTOR TEST RECORD | | | | | |
|---|---|---|---|---|---|
| **Motor Identification Remarks** | **Location** | **Specified Horsepower** | **Nameplate Horsepower** | **Nameplate Amperage (FLA)** | **Measured Amperage Under Normal Operating Conditions** |
| | | | | | |

**END OF SECTION**

## SECTION 26 05 73
## POWER SYSTEM STUDIES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall provide all power system studies for the Project as specified herein. The following shall be performed:

1. Short Circuit Studies

2. Protective Device Coordination Studies

3. Equipment Evaluation

4. Arc Flash Risk Assessment

B. The studies shall be prepared for all the modified portions of the power distribution system. The calculations shall be performed from the electric utility connection point for the Compressor Building and Solids Electrical Building, through the existing main service equipment, and all affected 480V equipment (Switchgears, MCCs, VFDs) and 208/120V panelboards.

C. The studies shall be prepared for the utility power sources. The studies shall evaluate several scenarios and make recommendations based on the worst-case conditions.

D. The Contractor shall provide the required data for the preparation of the studies.

E. Preliminary studies shall be prepared prior to ordering distributions equipment to confirm equipment rating. Final settings shall be based on the final study report.

F. Prior to receiving final approval of the distribution equipment shop drawings for the equipment proposed under this Contract and/or prior to release of that equipment for manufacture, the Preliminary Report, as specified herein, shall be submitted and approved. Contractor shall expedite the completion of the Preliminary Report so that final approval of proposed equipment is not delayed.

G. The studies shall be performed with the aid of SKM Systems Analysis Power Tools for Windows (PTW) software, Version 11.0 or newer or ETAP software by Operation Technology Incorporated, Version 22.5 or newer. No other software analysis packages are acceptable.

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## 1.02 CODES AND STANDARDS

A. All work shall be performed in accordance with the following codes and standards, as applicable (latest edition, unless otherwise specified):

1. IEEE

a. 141 – Recommended Practice for Electric Power Distribution for Industrial Plants

b. 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

c. 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

d. 3002.2 – IEEE Recommended Practice for Conducting Load Flow Studies and Analysis of Industrial and Commercial Power Systems

e. 3002.3 – IEEE Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems

f. 1584-2018 – IEEE Guide for Performing Arc-Flash Hazard Calculations

2. ANSI

a. C37.90 – IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

b. C37.91 – Guide for Protective Relay Applications to Power Transformers

c. C37.95 – Guide for Protective Relaying of Utility-Consumer Interconnections

d. C37.96 – Guide for AC Motor Protection

e. C57.12.59 – Guide Dry-Type Transformer Through-Fault Current Duration

f. C57.13 – IEEE Standard Requirements for Instrument Transformers

g. C57.109 – Guide for Liquid-Immersed Transformer Through Fault-Current Duration

h. Z535.4 – Product Safety Signs and Labels

3. NFPA

a. 70 – NEC

b. 70E, Standard for Electrical Safety in the Workplace (2024 Edition)

## 1.03 SUBMITTALS

A. The Contractor shall submit the following reports for review and approval:

1. One printed copy and one electronic copy of the Preliminary Report

2. One printed copy and one electronic copy of the Pre-Final Report

3. Three printed copies and one electronic copy of the Final Report

B. The Contractor shall submit one complete electronic copy of the final power system model and all required database files generated by the software analysis package used. Files shall be placed on portable storage media (USB 3.0 flash storage device) or be uploaded to a cloud-based file sharing service and be submitted with the Final Report. Furnish any necessary documentation requiring the Owner's signature to allow model to be transferred to the Owner.

C. All Reports shall bear the signature and seal of the licensed Professional Electrical Engineer that performed the study.

## 1.04 QUALIFICATIONS

A. The studies shall be performed by a Professional Electrical Engineer currently licensed in the state of Georgia. The licensed Professional Electrical Engineer shall have a minimum of 5 years of experience in performing power system studies.

B. The resume of the licensed Professional Electrical Engineer shall be submitted for approval prior to the start of work. An experience table shall also be provided detailing the power system studies of similar scope to this Contract that have been performed by the proposed Professional Engineer over the last 2 years. The table shall, at a minimum, list the facility owner's name, facility contact person with phone number and email address, and overall scope of work that was provided.

# PART 2 – PRODUCTS (NOT USED)

# PART 3 – EXECUTION

## 3.01 GENERAL

A. The studies shall include all portions of the electrical distribution system from the utility equipment, all the way down to and including the 208/120V panelboards. The studies shall include all transformers, low-voltage switchgear, motor control centers (MCCs), Variable Frequency Drives (VFDs) and panelboards as shown on the Drawings. System

connections and those which result in maximum fault conditions shall be adequately covered in the study.

B. In the event that the short circuit study requires a higher interrupting and/or withstand rating of equipment than the indicated in the Contract Documents, the Contractor shall furnish and install the equipment as required based on the study.

C. In the event that the short circuit study indicates that different settings or equipment is required than the specified ones, the Contractor shall furnish and install the equipment based on the study.

## 3.02 DATA COLLECTION

A. The Contractor shall collect all required utility transformer and service information for use in these studies. The serving electric utility representative contact information can be found in Section 26 05 00 – Basic Electrical Requirements.

B. Approved equipment shop drawings and product information for all equipment furnished under this Contract shall be used for these studies. Including data for equipment that is not yet approved is not acceptable.

C. One field visit to the Project Site to collect pertinent data from existing equipment by the personnel performing the studies is expected. The visit shall span as many days as required to collect all necessary information. This visit shall occur as soon after the Contract is awarded as possible and shall be coordinated with the Owner. The Contractor and personnel performing these studies are responsible for collecting all required data for these studies. If equipment is to be examined while energized parts are exposed, the examining personnel shall wear appropriate PPE in accordance with the requirements of NFPA 70E.

D. Using solely data from record drawings, “as-built” drawings, or a previous power system study is not acceptable. All data for existing equipment shall be field verified.

## 3.03 STUDY PARAMETERS

A. The following parameters shall be used for all studies:

1. Transformers 75kVA (nominal) and larger shall be modeled with actual nameplate data including impedance data. Motors 30hp and larger shall be modeled with actual nameplate power factor and efficiency data.

2. Room heating and cooling loads are mutually exclusive. Only the larger of these two load types shall be configured as in-service in the model.

3. Each set of pumps for a specific application (e.g., Final Effluent Water Pumps) has one redundant unit. For the purposes of these studies, that redundant unit shall be configured as out-of-service in the model.

4. The sources that shall be used in these studies are the serving electric utility sources.

B. Other parameters may apply for specific studies if noted in the respective study requirements herein.

## 3.04 SHORT CIRCUIT STUDIES

A. The short circuit studies shall be performed in accordance with IEEE Standard 3002.3.

B. The study input data shall include the short circuit contribution obtained from each source. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each bus. Single-line diagrams shall show the results of the analysis by using datablocks constructed as shown in Appendix A – Supplementary Information of this Section. Provide the results of this study in a tabular format as well, included as an appendix to the report.

C. The short circuit study report shall include an analysis of whether the equipment short circuit and withstand ratings shown in the Contract Documents are suitable.

## 3.05 PROTECTIVE DEVICE COORDINATION STUDIES

A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage circuit breaker trip characteristics and settings.

B. The coordination study shall include all equipment from the serving electric utility company source protective devices down to and including all adjustable circuit protective devices. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

C. The time-current characteristics of the proposed protective devices shall be printed on log-log scale coordination plots as specified as follows:

1. Each plot shall be accompanied by a representative single-line diagram. The coordination plot and single-line diagram shall each occupy one-half of the same printed sheet for ease of cross reference. Each printed sheet shall have a distinct title that identifies the portion of the electrical system it represents.

2. Each coordination plot shall include the following:

a. Sufficient number of separate curves shall be used to clearly indicate the coordination achieved

b. Identification of each curve with its respective component’s name

c. Complete operating bands for fuse and low-voltage circuit breaker trip curves

d. Transformer magnetizing inrush and ANSI transformer withstand parameters

e. Cable thermal overcurrent withstand limits

f. Significant symmetrical and asymmetrical fault currents for the portion of the electrical system represented by the plot

3. Each accompanying single-line shall include datablocks as described in Appendix A – Supplementary Information of this Section.

4. All restrictions of the National Electrical Code shall be adhered to, and proper coordination intervals and separation of characteristic curves shall be maintained.

D. The selection and settings of all protective devices shall be provided separately in the report in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings.

## 3.06 EQUIPMENT EVALUATION

A. An equipment evaluation shall be performed to determine the adequacy of existing circuit breakers, panelboards, motor control centers, automatic transfer switches, busses, etc. located at the facility by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents that result from the short circuit study.

B. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. A table shall be provided in the report showing the calculated fault currents and the corresponding short circuit ratings of the existing equipment along with a pass or fail status for each piece of equipment.

## 3.07 ARC FLASH RISK ASSESSMENT

A. An arc flash risk assessment shall be performed in accordance with IEEE Std. 1584-2018, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S. The assessment shall use the incident energy analysis method. The arc flash PPE category method shall not be used.

B. The following parameters shall be used for the arc flash risk assessment:

1. Working Distance for All Equipment: 18 inches

2. Arcing Duration Limit: 2 seconds, or higher (based on engineering judgement) for equipment locations where additional time may be required to exit the arc flash boundary.

3. Equipment box dimensions and electrode configuration shall be entered for each piece of equipment (existing and/or new) to be assessed. Using software default dimensions and electrode configuration is not acceptable.

4. For equipment operating at 240VAC or below, report incident energy as "<1.2 cal/cm$^2$" if the bolted fault current is calculated to be less than 2000A.

5. Any protective device settings changes that were recommended as part of these studies shall be included. For devices where settings changes are recommended, the "as-found" settings shall be documented separately in dedicated tables for record purposes.

6. The following operational scenarios shall be used in the assessment, with the worst-case values from each scenario being shown in the study report and on the arc flash labels:

    a. Scenario 1: All tie circuit breakers at distribution equipment are open, all main circuit breakers are closed, and the facility is served by the electric utility sources.

    b. Scenario 2: All A-side main circuit breakers at distribution equipment are open, all tie circuit breakers are closed, all B-side main circuit breakers are closed, and the facility is served by the electric utility B source.

    c. Scenario 3: All B-side main circuit breakers at distribution equipment are open, all tie circuit breakers are closed, all A-side main circuit breakers are closed, and the facility is served by the electric utility A source.

C. The arc flash risk assessment report shall include but not be limited to the following:

1. A brief overview of what arc flash hazards are and how to avoid them.

2. Definitions of key terms used in the report.

3. Confirmation of all parameters and scenarios used in the report.

4. Documentation of any assumptions made for the report.

5. Serving electric utility information received. Copies of the information received shall be included in an appendix.

6. Any recommendations to reduce the arc flash incident energies via protective device settings changes where incident energies are found to exceed 12 cal/cm$^2$. Protective device settings change recommendations shall not negatively impact selective coordination.

7. A copy of the PPE information from Table 130.5 G in NFPA 70E.

8. Arc flash labels as specified herein.

9. An NFPA 70E energized electrical work permit for each location where an arc flash label is provided.

10. An arc flash evaluation summary sheet, based on the worst-case scenario, that contains the following minimum information:

    a. Bus name

    b. Protective device name

    c. Bus line-to-line voltage

    d. Bus bolted fault

    e. Protective device bolted fault

    f. Protective device arcing fault

    g. Trip/delay time

    h. Breaker opening time

    i. Equipment type

    j. Gap

    k. Electrode configuration

    l. Box height, width, and depth

    m. Arc flash boundary

    n. Working distance

    o. Incident energy

    p. Notes

D. Arc Flash Labels

1. Arc flash labels shall be provided for each piece of equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. When opening an enclosure exposes energized parts on both the line and load side of a device, provide a label with the worst case (line versus load) incident energy

printed. The following equipment, at a minimum, shall be provided with labels in the quantities specified:

a. Switchgear/Switchboards: Quantity of 1 label per section on front, 1 label per section on rear if rear is accessible. Provide second label at main circuit breaker sections where it is possible to open covers and separately expose line side and load side energized parts.

b. Motor Control Centers: Quantity of 1 label per section on front, 1 label per section on rear if rear is accessible. Provide second label at main circuit breaker sections where it is possible to open covers and separately expose line side and load side energized parts.

c. Panelboards: Quantity of 1

d. Variable Frequency Drives: Quantity of 1 label per section

e. Other Stand-Alone Motor Starters/Controllers: Quantity of 1 label per section

f. Automatic and Manual Transfer Switches: Quantity of 1

g. Enclosed Circuit Breakers: Quantity of 1

2. Arc flash labels shall be thermal transfer type that is printed on adhesive backed polyester material. Labels shall be ANSI Z535.4 compliant, 4 inches tall by 6 inches wide, and provided with a 5-year warranty. For incident energy values of less than 40 cal/cm$^2$, the labels shall have an orange-colored header with the word “WARNING”. For incident energy values equal to and above 40 cal/cm$^2$, the labels shall have a red-colored header with the word “DANGER”. Each label shall include the following information:

a. Equipment name

b. Date of issue and name of firm performing assessment

c. Incident energy

d. Working distance

e. Arc flash boundary

f. Nominal system voltage

3. A generic arc flash label that has a red-colored header with the word “DANGER” and text in large letters that shows “ENERGIZED WORK NOT PERMITTED” shall be provided for the following equipment:

    a. Any equipment that requires an arc flash label (as previously specified herein) that is located within a hazardous area

    b. Any equipment found to be in poor working condition, where in the judgement of the engineer performing the study, energized work should not be performed at all, regardless of the outcome of the incident energy analysis at that equipment

    c. Any equipment with a portable generator connection point

## 3.08 STUDY REPORTS

A. The results of the studies shall be documented in a series of reports. A total of three separate reports shall be provided as follows:

1. Preliminary Report: The Preliminary Report shall consist of all power systems studies as specified herein, with the following exceptions:

    a. NFPA 70E energized electrical work permits shall not be included.

    b. One WARNING label and one DANGER label shall be printed on plain paper for format review purposes only. Actual adhesive labels with calculated values shall not be included.

2. Pre-Final Report: The Pre-Final Report shall incorporate all comments received from the previous report review and shall include specific equipment data from the approved shop drawings of the proposed electrical equipment. The Pre-Final Report shall consist of all power systems studies as specified herein, with the following exceptions:

    a. NFPA 70E energized electrical work permits shall not be included.

    b. Sample arc flash hazard warning labels (one WARNING label and one DANGER label) shall be printed on the proposed adhesive material for review purposes.

3. Final Report: The Final Report shall consist of all power systems studies as specified herein, including final adhesive arc flash hazard warning labels. Final report shall incorporate all installed electrical equipment, including any field changes made during construction, and all comments received from the previous report review. All ‘as-left’ protective device settings shall be included in the report. The Final Report shall bear the signature and seal of the professional electrical engineer that performed the study.

B. Hard copies of reports shall be furnished in the quantities specified herein, neatly organized into properly identified 3-ring binders. Tabs shall clearly separate each section of the report.

C. Electronic copies of reports shall be provided in Portable Document Format (.pdf) file format. Electronic copies shall have searchable text and bookmarks for each section of the report.

D. Each report shall begin with a table of contents followed by an executive summary. The executive summary shall detail the configuration of the electrical system and summarize any concerns or recommendations for the electrical distribution system that resulted from the studies specified herein.

E. Reports shall include simplified single line diagrams with only the device name information displayed for all equipment, as well as single line diagrams with specific data displayed as specified herein for each study.

F. All data used in the reports such as conductor sizes and lengths, motor sizes, utility contribution information, fault analysis input, fault contributions, and the like shall be included in the appendices of the report.

G. All single line diagrams and time current curves shall be provided in the reports on 11- x 17-inch paper, properly folded to fit into the report binder. Use of standard 8.5- x 11-inch paper for these purposes is not permitted. Single line diagrams shall be appropriately split up between several sheets (if required) to allow the drawing scale to be adjusted as required to make text and symbols legible.

## 3.09 FIELD ADJUSTMENT

A. The Contractor shall adjust all relay and other protective device settings according to the recommended settings table provided in the approved Pre-Final Report.

B. The Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

## 3.10 ARC FLASH LABEL PLACEMENT

A. The Contractor shall place approved adhesive arc flash labels on equipment after the Final Report is reviewed and approved.

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**APPENDIX A – SUPPLEMENTARY INFORMATION**

## REQUIRED DATABLOCK CONTENTS FOR POWER SYSTEM STUDIES

| Component Type | Input Data | Load Flow | Short Circuit | TCC Plots* |
|---|---|---|---|---|
| Utility | Nominal Voltage | Nominal Voltage<br>Current (A)<br>Power Factor<br>Power (kW)<br>Power (kVA) | Fault Contribution (3P RMS) and X/R Ratio<br>Fault Contribution (SLG RMS) and X/R Ratio | N/A |
| Generator | Nominal Voltage<br>Rating (kW)<br>Power Factor | Voltage Drop (%)<br>Power Factor<br>Power (kW)<br>Power (kVA) | Fault Contribution (3P RMS)<br>Fault Contribution (SLG RMS) | FLA |
| Bus | Voltage<br>Manufacturer<br>SCCR | Voltage Drop (%)<br>Study Voltage<br>Current (A)<br>Power Factor<br>Power (kW)<br>Power (kVA) | Fault Magnitude (3P RMS)<br>Fault Magnitude (SLG RMS) | N/A |
| Cable | Size (AWG or kcmil)<br>Parallel Sets<br>Length<br>Type (Cu/Al/Cu-Al) | Voltage Drop (%)<br>Current (A)<br>Power (kW)<br>Power (kVA) | Upstream Contribution (3P RMS)<br>Upstream Contribution (SLG RMS)<br>Downstream Contribution (3P RMS)<br>Downstream Contribution (SLG RMS) | N/A |
| Transformer | Rating (kVA)<br>Impedance (%Z)<br>X/R Ratio | Voltage Drop (%)<br>Sec. Current (A)<br>Power (kW)<br>Power (kVA) | Upstream Contribution (3P RMS)<br>Upstream Contribution (SLG RMS)<br>Downstream Contribution (3P RMS)<br>Downstream Contribution (SLG RMS) | N/A |
| Motor | Rating (hp)<br>Rated Voltage<br>FLA<br>Power Factor | Voltage Drop (%)<br>Study Voltage<br>Power Factor<br>Power (kW)<br>Power (kVA) | Upstream Contribution (3P RMS)<br>Upstream Contribution (SLG RMS) | FLA<br>LRA/FLA ratio |

| Component Type | Input Data | Load Flow | Short Circuit | TCC Plots* |
|---|---|---|---|---|
| Non-Motor Load | Rating (A, kW, kVA)<br>Rated Voltage<br>Power Factor | Voltage Drop (%)<br>Study Voltage<br>Power Factor<br>Power (kW)<br>Power (kVA) | N/A | N/A |
| Fuse | Manufacturer<br>Model<br>Rating (A) | N/A | N/A | Same as Input Data |
| Relay** | Manufacturer<br>Model<br>CT Ratio<br>Curve Elements & Settings | N/A | N/A | Same as Input Data |
| Disconnect Switch | Manufacturer<br>SCCR (kA) | N/A | N/A | N/A |
| Circuit Breaker<br>(no integral trip unit) | Manufacturer<br>SCCR (kA) | N/A | N/A | N/A |
| Circuit Breaker***<br>(all others) | Manufacturer<br>Model<br>SCCR (kA)<br>Frame/Sensor/Plug Ratings<br>Settings***<br>LTPU<br>[LTD Curve Shape]<br>[LTD]<br>[STPU]<br>[STD and $I^2T$ On/Off]<br>INST<br>[GFPU]<br>[GFD and $I^2T$ On/Off]<br>[AF Maint. Setting/Curve] | N/A | N/A | Same as Input Data |

| Component Type | Input Data | Load Flow | Short Circuit | TCC Plots* |
|---|---|---|---|---|
| Motor Circuit Protector | Manufacturer<br>Model<br>SCCR (kA)<br>Frame/Trip Ratings | N/A | N/A | Same as Input Data |
| Motor Overload Relay | Manufacturer<br>Model<br>SCCR (kA)<br>Frame/Trip Ratings<br>Settings | N/A | N/A | Same as Input Data |

* TCC single line diagrams shall not display datablocks.

** Complex and/or non-overcurrent settings for multifunction relays (e.g. bus/winding differential, motor thermal model parameters, under/overvoltage, RTD alarm and trip setpoints, etc.) are excluded from the model.

*** Hide setting elements where not applicable for a given circuit breaker. Recommended settings for non-overcurrent settings for electronic trip circuit breakers (e.g. under/overvoltage, zone-selective interlocking, alarm setpoints, etc.) are excluded from the model.

**END OF SECTION**

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## SECTION 26 09 16
## ELECTRIC CONTROLS AND RELAYS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.

B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and Labeled in compliance with IEC standards is not acceptable.

C. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 – Identification for Electrical Systems

### 1.02 CODES AND STANDARDS

A. Products specified herein shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/International Society of Automation (ISA)

    a. ANSI/ISA 12.12.01 – Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

2. National Electrical Manufacturers Association (NEMA)

    a. NEMA 250 – Enclosures for Electrical Equipment

3. National Fire Protection Association (NFPA)

    a. NFPA 70 – National Electrical Code (NEC)

4. Underwriters Laboratories (UL)

    a. UL 508A – Standard for Industrial Control Panels

b. UL-1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

B. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Shop drawings shall include but not be limited to:

1. Product data sheets.

## 1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:

1. One contact block of each type furnished on the project

2. One indicating light lens of each color furnished on the project

3. One LED lamp of each color furnished on the project

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## PART 2 – PRODUCTS

### 2.01 CONTROL COMPONENTS

A. Manufacturers

1. Control components shall be manufactured by The Square D Company, GE by ABB, Allen-Bradley, Siemens Energy and Automation, or Engineer approved equal.

B. Pilot Devices

1. General

a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (e.g., HAND-OFF-AUTO, RUN, EMERGENCY STOP).

b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.

c. All pilot devices shall be 30.5-mm in diameter, unless otherwise indicated. 22-mm devices are not acceptable.

d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

e. In Class I, Division 2 hazardous locations, pilot devices shall be the hermetically sealed type, constructed in accordance with ANSI/ISA 12.12.01.

2. Pushbuttons

a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.

b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one spare normally open and one spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

3. Selector Switches

a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.

b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one spare normally open and one spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Where indicated in the Drawings or Specifications, provide spring return positions.

d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

4. Indicating Lights

a. Indicating lights shall be LED type, with the proper voltage rating to suit the application, and push-to-test feature.

b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

| Color | Designation |
|---|---|
| Green | "Run", "On", “Open” |
| Red | "Off", “Closed” |
| Amber | "Alarm", "Fail" |
| White | “Control Power On” |

5. Emergency Stop and Tagline Switches

    a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35-mm-diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.

    b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.

    c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one spare normally open and one spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

C. Relays and Timers

1. General

    a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.

    b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.

    c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

2. Control and Pilot Relays

    a. Relays shall have a clear or translucent housing that allows the contacts to be visually inspected without disassembly.

    b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

    c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.

3. Time Delay Relays

    a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.

b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.

d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.

4. Elapsed Time Meters

a. Elapsed time meters shall be non-resettable type with no less than a four (4) digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.

D. Control Terminal Blocks

1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 through #8 AWG.

2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (e.g., 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

## 2.02 LOCAL CONTROL STATIONS

A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.

B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.

C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area

in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Wet Process Area | NEMA 4X, Type 316 Stainless Steel |
| Indoor Dry Process Area | NEMA 12, Die Cast Zinc |
| Indoor Dry Non-process Area | NEMA 12, Die Cast Zinc |
| Indoor Type 1 Chemical Storage/Transfer Area | NEMA 4X, Fiberglass or Thermoplastic Polyester |
| Indoor Type 2 Chemical Storage/Transfer Area | NEMA 4X, Type 316 Stainless Steel |
| All Outdoor Areas | NEMA 4X, Type 316 Stainless Steel |

D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

| Area Classification | Enclosure Type and Material |
|---|---|
| Class I, Division 1, Group D | NEMA 7, Die Cast Aluminum |
| Class I, Division 2, Group D | NEMA 4X, Type 316 Stainless Steel |
| Class II, Division 1, Group F | NEMA 9, Die Cast Aluminum |
| Class II, Division 2, Group F | NEMA 9, Die Cast Aluminum |

E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure. Where located outdoors or in indoor wet process areas, NEMA 7 and NEMA 9 enclosures shall also carry a NEMA 4X rating.

F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class I, Division 1 and Class II, Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class I, Division 2 hazardous locations shall be in accordance with ANSI/ISA 12.12.01-2013.

G. Provide a nameplate on each local control station in accordance with Section 26 05 53 – Identification for Electrical Systems. The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words “LOCAL CONTROL STATION”.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Local control stations shall be mounted, nominally, at 4ft 6in above finished floor or finished grade to the centerline of the enclosure, at the equipment height where appropriate and permitted by the NEC, or as shown otherwise on the Drawings.

C. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.

D. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The device shall be bonded to the equipment enclosure with an insulated green bonding conductor.

E. Local control station covers shall be bonded to the local control station enclosure with an insulated green bonding conductor.

F. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.

G. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the Engineer.

**END OF SECTION**

# SECTION 26 22 00
# LOW-VOLTAGE TRANSFORMERS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation transformers for power and lighting distribution systems as specified herein, as indicated on the Drawings, and as required to complete the electrical installations.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 – Identification for Electrical Systems

C. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Transformers shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE)

   a. ANSI/IEEE C57.12.01 – Standard for General Requirements for Dry -Type Distribution and Power Transformers

2. National Electrical Manufacturers Association (NEMA)

   a. NEMA ST 20 – Dry Type Transformers for General Applications

3. National Fire Protection Association (NFPA)

   a. NFPA 70 – National Electrical Code (NEC)

4. Underwriters Laboratories (UL)

   a. UL 1561 – Dry-Type General Purpose and Power Transformers

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5. U.S. Department of Energy 2016 Efficiency Standards

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Division 01, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Reports of Certified Shop Field Tests

## 1.04 SHOP DRAWINGS

A. Shop drawings shall include but not be limited to:

1. Product data sheets

2. Drawings showing clearly marked dimensions and weight for each transformer

3. Sample equipment nameplate diagram

B. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., TX-26A).

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

## 1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## 1.07 IDENTIFICATION

A. Each transformer shall be identified with the equipment item number indicated on the Contract Drawings and the accepted Shop Drawings. A nameplate shall be securely affixed in a conspicuous place on each transformer. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The equipment covered by this Section is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Dry type distribution transformers shall be Energy Star compliant and manufactured by the Square D Company, GE by ABB, or Siemens Energy and Automation, Inc.

### 2.02 DRY TYPE TRANSFORMERS

A. Furnish and install single-phase and three-phase general purpose, dry-type transformers, as specified herein and indicated on the Drawings. The transformers shall be 60 Hz, self-cooled, quiet-design insulated of the two-winding type.

B. The transformers shall be UL 1561 Listed.

C. The primary windings shall be rated 480VAC for use on 3-phase systems and connected delta unless indicated otherwise on the Drawings. KVA ratings shall be as shown on the Drawings. Furnish transformers with two 2-1/2% primary taps above, and four 2-1/2% primary taps below rated voltage for transformers 15 KVA and above, and two 2-1/2% primary taps above, and two 2-1/2% primary taps below rated voltage for transformers less than 15 kVA. All taps shall be full capacity rated.

D. The ratings of the secondary windings shall be as indicated on the Drawings.

E. Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI/IEEE C57.96. This performance shall be obtainable without exceeding 150 degrees Celsius average temperature rise by resistance or 180 degrees Celsius hot spot temperature rise in a 40-degree Celsius maximum ambient and 30 degrees Celsius average ambient. The maximum coil hot spot temperature shall not exceed 220 degrees Celsius. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM D635. All insulating materials shall be in accordance with NEMA ST 20 Standard for a 220 degrees Celsius UL component recognized insulation system.

F. Transformer coils shall be of the continuous wound copper construction and shall be impregnated with non-hygroscopic, thermosetting varnish.

G. All cores are to be constructed of high grade, non-aging, grain-oriented silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration-absorbing mounts to minimize

sound transmission. There shall be no metal-to-metal contact between the core and coil assembly and the enclosure.

H. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees Celsius. Transformers shall be furnished with lugs of the size and quantity required and suitable for termination of the field wiring.

I. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

J. Transformers shall have core and coil assemblies mounted on rubber isolation pads to minimize the sound levels. Transformers shall not exceed the sound levels listed in NEMA ST-20.

K. Transformers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| **Area Designation** | **Enclosure Type and Material** |
|---|---|
| Indoor Wet Process Area | NEMA 3R, Painted Steel |
| Indoor Dry Process Area | NEMA 2, Painted Steel |
| Indoor Dry Non-Process Area | NEMA 2, Painted Steel |
| All Outdoor Areas | NEMA 3R, Painted Steel |

L. The enclosure shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with a baked weather-resistant enamel using the manufacturer's standard painting process. Color shall be ANSI 49 or 61 grey.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. The transformers shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.

B. Conduit routed to and from the transformer shall be arranged for easy removal of the transformer access covers.

C. Where transformers 50 kVA and smaller are shown to be wall mounted, a transformer manufacturer supplied wall mounting kit shall be used. The lowest point of the wall mounting bracket shall be no lower than 7 feet above the finished floor. Field fabricated

mounting hardware is not acceptable unless reviewed and approved in writing by the Engineer.

D. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests

a. The transformers shall be given routine factory tests in accordance with the requirements of the ANSI and NEMA standards. Temperature rises may be certified from basic design.

b. As a minimum, the following tests shall be made on all transformers:

1) Ratio tests on the rated voltage connection and on all tap connections.

2) Polarity and phase-relation tests on the rated voltage connection.

3) Applied potential tests.

4) Induced potential tests.

5) No-load and excitation current at rated voltage on the rated voltage connection.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

b. Insulation between windings shall be tested by 1000 VDC Megohmmeter for 1 minute. Resistance value shall be no less than 100 Megaohms.

**END OF SECTION**

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# SECTION 26 24 16
# PANELBOARDS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation panelboards as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles, and arrangements/ locations conforming to the panelboard schedules shown on the Drawings.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 –Identification for Electrical Systems

3. Section 26 43 13 – Surge Protective Devices

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Electrical Contractors Association (NECA)

   a. NECA 407 – Standards for Installing and Maintaining Panelboards

2. National Electrical Manufacturers Association (NEMA)

   a. NEMA PB 1 – Panelboards

3. National Fire Protection Association (NFPA)

   a. NFPA 70 – National Electrical Code (NEC)

4. Underwriters Laboratories (UL)

   a. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations

   b. UL 67 – Standard for Panelboards

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c. UL 489 – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

d. UL 943 – Ground Fault Circuit Interrupters

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Operation and Maintenance Manuals

4. Reports of Field Tests

## 1.04 SHOP DRAWINGS

A. Shop drawings shall include but not be limited to:

1. Product data sheets

2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard

3. Complete panelboard schedules indicating circuit designations as shown on the Drawings for each panelboard

B. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., LP-26A, PP-26B).

## 1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01. The manuals shall include:

1. Instruction books and/or leaflets

2. Recommended spare parts list

3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and during field installation

## 1.06 SPARE PARTS

A. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer. All spaces in the panelboards shall be furnished with a spare breaker as indicated in the panelboard schedules shown on the Drawings.

A. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## 1.07 IDENTIFICATION

A. Each panelboard shall be identified with the identification name/number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each panelboard. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment shall be designed, constructed, and installed in accordance with the best practices of the trade and shall operate satisfactorily when installed as shown on the Drawings.

B. It is the intent of this Section that the panelboards be produced by a single manufacturer who shall be responsible for matching all components and providing equipment which functions together as a system.

C. Distribution panelboards, those identified with a prefix “DP” on the Drawings, shall be the I-Line Series by Square D, GE by ABB equivalent, or Siemens Energy and Automation, Inc. equivalent.

D. Power panelboards, those identified with prefix “PP” on the Drawings, shall be the NF Series by Square D, GE by ABB equivalent, or Siemens Energy and Automation, Inc. equivalent.

E. Lighting and instrument panelboards, those identified with prefix “LP” and “IP” respectively on the Drawings, shall be the NQ Series by Square D, GE by ABB equivalent, or Siemens Energy and Automation, Inc. equivalent.

F. Combination power units shall be Mini-Power Zone Series by Square D, GE by ABB equivalent, or Siemens Energy and Automation, Inc. equivalent.

## 2.02 PANELBOARDS

A. General

1. Panelboards shall be dead-front type and shall be of the configuration and rating as specified herein and indicated on the Drawings. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards.

2. Where specified herein, indicated on the Drawings, or required, panelboards shall be rated for service entrance and bear a service entrance label.

3. Panelboards shall be equipped with a main circuit breaker or main lugs complete with branch circuit breakers, as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting as indicated on the Drawings.

4. Panelboards shall be fully rated and shall have a minimum short circuit rating of 22,000 amperes symmetrical for units rated 240VAC and below and 42,000 amperes symmetrical for units rated above 240VAC, unless otherwise indicated on the Drawings.

B. Enclosures

1. Enclosures shall be UL 50 Listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed of No. 12 U.S.S. code gauge galvanized steel, painted ANSI 49 or ANSI 61 gray. The enclosure shall have wiring gutters on the sides and shall be at least 5-3/4 inches deep. Wiring gutters shall be large enough to allow compliance with NEC minimum bending radius requirements for all cables to be terminated, including future cables sized for any spare circuit breakers that are shown on the Drawings.

2. All panelboards shall be provided with a dead front style trim. Additional trim requirements are as follows:

   a. Distribution panelboards with enclosures that are rated other than NEMA 12 shall have hinged covers over each vertical wiring gutter to allow access to all branch mounted device terminations without removing the panel trim.

   b. Power, lighting, and instrumentation panelboards with enclosures that are rated other than NEMA 12 shall be provided with a full height hinge where it is attached to the panelboard box. Trim shall be attached to the panelboard enclosure using concealed trim clamps. Resultant trim assembly shall allow work inside the enclosure without the need to remove the panel trim from the enclosure.

3. Panelboard trims shall include a door over the dead front area to provide access to the circuit breakers and other devices. The access door shall be fastened to the trim with concealed hinges and be equipped with flush-type catches. Access doors exceeding 40 inches in height shall be equipped with a vertical bolt three-point locking mechanism, all other doors shall have a single-point mechanism. All locks shall be keyed alike.

4. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, number of wires, and bus ratings.

C. Bus Work

1. Where 3-wire bus is indicated on the Drawings, the panelboard shall be furnished with 3-phase busses and a ground bus. In addition, if a transformer with a grounded wye secondary is shown on the Drawings to be supplying a 3-wire panelboard, a neutral landing pad shall be furnished within the panelboard to provide a place to terminate the grounded conductor. Providing a 4-wire bus (3 phases plus neutral) for a 3-wire system is not acceptable.

2. Where a 4-wire bus is indicated on the Drawings, the panelboard shall be furnished with 3-phase busses, a neutral bus of equal ampacity to the phase bus, and a ground bus.

3. Main bus bars shall be sized in accordance with UL 67 to limit the temperature rise on any current carrying part to a maximum of 65 degrees C above a maximum ambient of 40 degrees C.

4. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.

5. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.

6. All bus shall be tin-plated copper and shall extend the entire useable length of the panelboard, including spaces.

7. Where required by the NEC, a bonding jumper, sized in accordance with the NEC, shall be installed between the panelboard ground bus and the neutral bus or neutral landing pad.

D. Circuit Breakers

1. Main and branch circuit breakers shall be bolt-on, UL 489 Listed molded-case type with trip ratings as indicated on the Drawings. Unless otherwise indicated, circuit breakers shall be manually operable, with automatic trip-free operation, and shall provide inverse-time-limit overload and instantaneous short-circuit protection. All

circuit breakers shall have quick-make, quick-break, toggle mechanisms for manual as well as automatic operation.

2. Main circuit breakers shall be individually mounted. Branch-mounted main circuit breakers are not acceptable unless specifically indicated on the Drawings. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location(s).

3. Tandem or half-size circuit breakers are not acceptable.

4. Circuit breaker voltage ratings shall meet or exceed the panelboard voltage indicated on the Drawings. The number of poles and trip ratings shall be as indicated on the Drawings. Where a trip rating is not indicated on the Drawings, provide a 20A circuit breaker.

5. Circuit breakers for panelboards rated 240VAC and below shall have an interrupting rating at 240VAC that matches the panelboard short circuit rating. Circuit breakers for panelboards rated above 240VAC shall have an interrupting rating at 480 VAC that matches the panelboard short circuit rating.

6. Unless indicated otherwise on the Drawings, circuit breakers with smaller than 225-ampere frames shall be the thermal-magnetic type. Thermal and magnetic trip elements may be fixed or adjustable.

7. Where indicated on the Drawings, and for circuit breakers of 225-ampere frames and larger, circuit breakers shall have interchangeable electronic trip units (ETU) and adjustable trip elements and time delays. Provide electronic trip units with the adjustable functions indicated on the Drawings (e.g., Long, Short, Instantaneous, Ground).

8. Where indicated on the Drawings, or where required by Code, circuit breakers shall be equipped with integrally mounted ground fault circuit interrupters (i.e., GFI/GFCI) complete with "TEST" push button, and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. Ground fault circuit interrupter style circuit breakers shall be UL 943 Listed. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD". Where required by Article 440 of the NEC, circuit breakers installed for air conditioning units shall be HACR type.

9. Where indicated on the Drawings, circuit breakers shall be 100% rated.

10. Where indicated on the Drawings, main circuit breakers shall be provided with a shunt trip device to trip the breaker from a remote location by means of a trip coil energized from a separate circuit. A 120 VAC shunt trip shall be capable of operating at 55% or more of rated voltage. All other shunt trips shall be capable of operating at 75% or more of rated voltage.

11. Where indicated on the Drawings, or as required, circuit breakers shall be provided with a padlockable hasp or handle padlock attachment (lock-off device) for padlocking in the “OFF” position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Where indicated on the Drawings, or as required, branch circuit breakers shall be provided with a similar attachment (lock-on device) for padlocking in the “ON” position for critical circuits (e.g., fire alarm control panel circuits) which must remain energized.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard (including both new panelboards and existing panelboards modified under this project). The Contractor shall maintain in each panelboard, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

## 2.03 SURGE PROTECTIVE DEVICES

A. Surge protective devices (SPDs) shall be provided either integral to the panelboard or as a separate unit external to the panelboard enclosure, as indicated on the Drawings. See Section 26 43 13 – Surge Protective Devices for SPD requirements.

B. Integral SPDs shall be installed within the panelboard enclosure in a location that allows the required quantity and rating of branch circuit breakers to be installed. Reducing the quantity of branch circuit breakers to less than that required by the panel schedules is not acceptable.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Panelboards shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer, and as required by NECA 407.

B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed 6 feet above finished floor elevation.

C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on

concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.

D. The Contractor shall not use factory furnished knockouts with surface mounted back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush mounted back boxes with manufacturer's standard pattern of knockouts.

E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush mounted enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.

F. Bus loads in all panelboards shall be balanced between phases to within a tolerance of 1 KVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practical.

G. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Field Tests

a. Prior to termination of any conductors to the circuit breakers, all bus work and circuit breakers shall be tested from phase to phase and phase to ground with a 1000 VDC megohmmeter for 1 minute in accordance with NECA 407. Resistance values shall be recorded and shall not be less than 100 megohms.

b. Prior to terminating any wires to the circuit breakers, the resistance of the connection between the bus work and each circuit breaker shall be tested through the use of a low-resistance ohmmeter. Record the resistance values for each circuit breaker.

**END OF SECTION**

## SECTION 26 24 19
## LOW-VOLTAGE MOTOR CONTROL CENTERS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation, the motor control centers as specified herein and indicated on the Drawings.

B. The Contractor shall obtain the motor control centers from one manufacturer who shall also manufacture the enclosure and major equipment components, which includes, but is not limited to, motor starters, motor controllers, circuit breakers, power monitoring equipment, and other components of the equipment assembly as indicated on the Drawings. Subcontracting of wiring is not acceptable.

C. The motor control center shall be assembled using NEMA-rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

D. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 19 – Low-Voltage Conductors and Cables

3. Section 26 05 53 – Identification for Electrical Systems

4. Section 26 09 16 – Electric Controls and Relays

5. Section 26 43 13 – Surge Protective Devices

### 1.02 CODES AND STANDARDS

A. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE)

a. ANSI/IEEE C12.1 – Code for Electricity Metering

b. ANSI/IEEE C57.13 – Instrument Transformers

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2. National Electrical Manufacturers Association (NEMA)

    a. NEMA 250 – Enclosures for Electrical Equipment

    b. NEMA ICS 1 – Industrial and Control Systems General Requirements

    c. NEMA ICS 2 – Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

    d. NEMA ICS 18 – Motor Control Centers

3. National Fire Protection Association (NFPA)

    a. NFPA 70 – National Electrical Code (NEC)

4. Underwriters Laboratories (UL)

    a. UL 489 – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

    b. UL 845 – Motor Control Centers

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Proposed Testing Methods and Reports of Certified Shop and Field Tests

4. Manufacturer’s Installation Certification

5. Operation and Maintenance Manuals

## 1.04 SHOP DRAWINGS

A. Shop drawings for each motor control center shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this Specification Section. In the left margin beside each

and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

2. Product data sheets for all equipment comprising each MCC.

3. Example equipment nameplate data sheet.

4. Approximate total shipping weight of each shipping split.

5. Plan, front, and side view drawings, including overall dimensions of each motor control center. Identify shipping splits and show conduit stub-up area locations on the Drawings.

6. Internal schematic and point-to-point wiring diagrams of each motor starter and/or motor control unit integrated into the motor control center. Standard wiring diagrams that are not custom created by the manufacturer for the motor control centers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g., supply fans) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

7. Complete single-line diagrams for each motor control center showing circuit breakers, motor starter units, motor controllers, and other equipment connected to the bus in the MCC. Indicate electrical ratings of equipment and devices on these single-line diagrams or in a tabular format. Ratings shall include starter size and type, motor circuit protector continuous current rating, circuit breaker frame size and trip rating, instrument transformers, meters, relays, timers, control devices, motor horsepower and full load current, and similar information.

8. Bill of material list for each motor control center and each motor control unit.

9. Nameplate schedule for each motor control center.

10. Manufacturer's installation instructions.

11. Key interlock scheme drawing and sequence of operations.

12. Manufacturer’s Warranty Statement

13. Table listing all motor loads connected to the motor control center. Table shall include the full load amps and locked rotor amps of the APPROVED motors. Final approval of MCC shop drawings cannot be given until all motor loads for MCC have been reviewed, approved, and shown in this table.

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01. The manuals shall include, but not be limited to:

1. Instruction books and/or leaflets

2. Spare parts list

3. Final as-built construction drawings (updated from those included in the Shop Drawings) incorporating all changes made in the manufacturing and installation process

4. All other drawings, product information, and other materials originally included in the Shop Drawings, updated as necessary to reflect as-built conditions

## 1.06 SPARE PARTS

A. MCCs shall be furnished with installed spare circuit breakers and/or motor starters/controllers where indicated on the Drawings.

B. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts for each motor control center:

| Number Required | Description |
|---|---|
| 1 | Circuit breaker for each type, size, and rating provided (except main circuit breakers) |
| 1 | Motor circuit protector for each type, size, and rating provided |
| 1 | Relay of each type and size provided |
| 1 | Starter coil and complete set of contacts for each size and type of starter provided |
| 2 sets | Fuses of each size and type provided |
| 1 | Control power transformer of each size and type provided |
| 2 | Lamps and lenses for indicating lights, each color |
| 2 | Indicating lamp sockets for each type provided |

| Number Required | Description |
|---|---|
| 1 | Pilot device (e.g., pushbutton, selector switch) complete with contact blocks and legend plates for each type, color, size, and rating provided. |

C. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## 1.07 IDENTIFICATION

A. Each motor control center shall be identified with the identification number indicated on the Drawings (e.g., MCC-26). A nameplate shall be securely affixed in a conspicuous place on each motor control center. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

## 1.08 WARRANTY

A. Contractor and Manufacturer shall warrant that the material and workmanship of all components and the operation of the equipment is in accordance with the latest design practices and meets the requirements of this Section.

B. Warranty shall include, but not be limited to, the following:

1. Replace equipment/components found to be faulty, make changes in equipment arrangement, and/or make adjustments necessary to meet the equipment or functional requirements of this Section.

2. System rewiring and component substitution/rebuild.

3. All accessories and appurtenances provided by the equipment manufacturer.

C. Warranty for <u>each</u> MCC line-up shall be in effect for a period of 24 months following final acceptance of the MCC.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment covered by this Section is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. It is the intent of these specifications that all components of the motor control center be provided by one manufacturer who shall have the sole responsibility of matching all

components and providing equipment which functions together as a system. The manufacturer of the motor control center shall also be the manufacturer of the motor controllers. The use of third-party supply and assembly of these components is not acceptable.

C. Motor control centers shall be using NEMA rated contactors and starters and shall be Model 6 as manufactured by the Square D Company, Centerline 2100 as manufactured by Allen-Bradley, or ReliaGear LV MCC by ABB.

## 2.02 MOTOR CONTROL CENTER

A. General

1. The motor control centers shall be 600 VAC class suitable for operation on a three-phase, 60 Hz system. The motor control centers and their components shall conform to the requirements of applicable standards of NEMA ICS 2 and UL 845. Wiring shall be NEMA Class II, Type B-t. Each vertical section shall be a NEMA 1A (gasketed) industrial use enclosure unless otherwise specified or indicated on the Drawings.

2. The enclosures shall be cleaned, primed, and finish coated in accordance with the manufacturer's standard process. The pre-treatment process shall be a zinc chromate primer followed by a "One Coat" paint process that is monitored to meet the manufacturer's specifications for paint color, texture, thickness, and durability. Enclosure interior and exterior finish color shall be ANSI 49 or ANSI 61. The color of the back panel/bucket located within the MCC enclosure shall be white.

3. The motor control centers shall be capable of withstanding the fault current available at its line terminals. Minimum bus bracing, withstand, and interrupting ratings are specified herein.

4. Unless otherwise specified or indicated on the Drawings, each vertical section shall be approximately 20 inches wide, and 90 inches high, 20 inches deep, and shall not contain more than six NEMA Size 1 starters. Motor control centers shown "back-to-back" on the Contract Drawings shall be complete motor control assemblies placed back-to-back in the location shown. Motor control center sections with common horizontal and/or vertical bus systems are unacceptable.

5. Continuous horizontal wiring troughs shall be provided at both the top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the motor control center. Each section shall be provided with a large, continuous, full height vertical wiring trough in the right side of each section. Each vertical wiring trough shall be furnished complete with tie bars for conductor support.

6. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105°C. Wire color coding shall be red for control and black for power. Wire numbers shall not be repeated in a motor control center.

7. Starter units shall contain the number of auxiliary contacts, unit-mounted pilot devices and indicating lights, control relays, elapsed time meters, and other devices as shown on the Drawings and required for the applications. A minimum of two normally open and two normally closed spare contacts shall be provided for each magnetic starter. These spare contacts shall be shown on the submittal wiring diagrams.

8. The motor control centers shall be furnished with warning signs to notify maintenance personnel of multiple sources of power within the motor control units.

B. Power

1. The motor control centers shall be supplied from a 480V, 3-phase, 3 or 4 wire as indicated on the Drawings, 60 Hz power source. The incoming power feeders shall be sized as shown on the Drawings.

C. Bus

1. Main horizontal bus shall be installed through all MCC sections, be made of tin-plated copper, and have an ampacity rating as shown on the Drawings. Where 4-wire bus is shown on the Drawings, a horizontal neutral bus shall also be installed through all MCC sections, be made of tin-plated copper, and have an ampacity to match the main horizontal bus.

2. Full height vertical bus shall be installed in all sections including those containing spare units and "prepared" spaces. Vertical bus shall have an ampacity as required to accommodate the units in each section but shall be no less than 300A. Vertical bus for sections containing “prepared” spaces shall have an ampacity of no less than 600A. Vertical bus shall be tin-plated copper.

3. The bus shall be braced for 65,000A rms symmetrical at 480V unless otherwise indicated on the Drawings. The horizontal bus shall be effectively isolated from all wiring troughs and other working areas. Vertical bus extensions shall be isolated by rigid, glass-polyester moldings so as to be a separate self-supported assembly. No extra safety jacks or similar devices shall be required to obtain an essentially dead-front condition. Access shall be provided for inspection and maintenance from the front. Bus sizing shall be in accordance with UL 845 to limit the temperature rise on any current carrying part to a maximum of 65 degrees C above a maximum ambient of 40 degrees C.

4. The horizontal ground bus shall be tin plated copper and located in the bottom horizontal wireway. The minimum size of the horizontal ground bus shall be 1/4-inch x 1 inch (6.35 mm x 25.4 mm) or 33% of the main horizontal bus ampacity, whichever is greater.

5. Compression lugs shall be mounted on the ground bus in each section, in the size and quantity as required for the termination of system and equipment grounding conductors.

6. The vertical ground bus shall be tin plated copper and be solidly connected to the horizontal ground bus. This ground bus, in combination with the unit ground bus stab, establishes unit grounding before the plug-in power stabs engage the power bus, and conversely, as the unit is withdrawn, grounding is maintained until after the plug-in power stabs are disengaged.

D. Incoming Line Units

1. Each incoming line unit shall contain a main circuit breaker or main lug only connections as indicated on the Drawings. Main lug only sections shall have buswork and fittings as required with cable lugs for cables of sizes and quantities shown on the Drawings. Cable lugs for connecting to MCC bus 1600A and larger shall be irreversible compression type; lugs for all smaller bus connections shall be mechanical type lugs. Cable lugs shall be suitable for their respective conductors.

2. Main circuit breaker and main lug sections shall be configured for top or bottom conduit entry as required. Unless otherwise noted, the Contractor is responsible for coordinating top or bottom conduit entry requirements with the MCC Manufacturer.

E. Unit Compartments

1. Each unit compartment shall be provided with an individual front door hinged to the vertical structure. Each plug-in unit shall be supported and guided by a removable unit support pan, so that the unit rearrangement is easily accomplished. The rearrangement of the unit support pan from one location to the other shall be accomplished without use of tools. After insertion, each plug-in unit shall be held in place by at least one multi-turn latch, located at the front of the unit. The latch shall be located for front accessibility and installation convenience. An additional mechanical interlock shall be provided to prevent withdrawal of the unit from the stationary structure with the operating mechanism in the ON position.

2. The unit plug in power stabs shall be electromagnetically tin-plated copper to yield a low-resistance connection and designed to tighten during heavy current surges and short circuits. The stab shall be backed by spring steel clips to provide and maintain a high pressure, two-point connection to the vertical bus. They shall be free floating and self-loading plug-in. Wiring from the unit disconnecting means to

the plug-in stab shall be exposed at the rear of the unit. The power cable terminations at the plug-in stab shall be mounted in a two-piece, glass polyester support assembly. This support assembly shall provide a separate isolated pathway for each phase, minimizing the probability of a unit fault condition reaching the power bus system.

3. NEMA Size 1 through Size 5 non-reversing starters shall be plug-in units. Size 1, 2, and 3 shall utilize stab assembly rated 100A. Stab assemblies for Size 4 and Size 5 starters shall be rated for the starters maximum output current rating.

4. An industrial, heavy-duty flange handle mechanism shall be supplied for the control of each disconnecting means. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position. The operator handles shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator. It shall be possible to lock the handle in the "OFF" position with up to three 3/8-inch-diameter shackle padlocks and in the "ON" position with one 3/8-inch-diameter shackle padlock.

5. The operator handle of all units shall be interlocked with the door units so that the disconnect means cannot be switched unless the door unit is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the off position. An externally operated defeater requiring the use of a screwdriver shall provide access to the unit without interrupting service.

6. The overload relays shall be resettable from the outside of the enclosure by means of an insulated bar or button.

F. Isolation and Insulation

1. Horizontal bus access covers and vertical bus covers shall isolate the energized buses to guard against the hazard of accidental contact. These covers shall be molded of a glass polyester material.

2. The horizontal bus shall be isolated from the top horizontal wireway by a grounded steel barrier. This barrier shall be removable to allow access to the bus and connections for maintenance.

3. The vertical bus cover shall provide unit plug-in openings which shall permit unit plug-in stab assemblies to pass through and engage the vertical bus. The unit plug-in openings shall be sized to minimize the probability of inadvertent contact with the vertical bus.

4. Isolation of unused stab openings shall be accomplished by use of a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the motor control center.

5. All units shall be isolated from one another, above and below, by unit support pans or steel barriers, which can remain in place when the units are withdrawn.

6. Incoming line compartments shall be isolated from horizontal and vertical wireways by steel barriers.

7. A molded unit isolating barrier shall be provided to isolate the unit from the vertical wireway.

G. Combination Motor Control Units

1. Motor branch circuits shall be protected by a motor circuit protector (MCP). MCP sizes shall be selected by the MCC manufacturer based on the motor nameplate information gathered and listed in the table required herein. MCP shall have an adjustment range that allows for between 800% and 1200% of motor nameplate FLA.

2. The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break overcenter switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.

3. Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic only element. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes, consisting of metal grids mounted in an insulating support.

4. The motor circuit protectors in combination with a contactor and overload relay shall have an interrupting rating that matches the motor control center short circuit rating at 480V.

H. Motor Starters

1. Motor starters shall conform to NEMA Standard ICS 1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment. The size of the starter shall be as required for the particular load. Minimum starter size shall be NEMA

Size 1. Size 1 and 2 starters shall be completely drawout type, so that units may be withdrawn without disconnecting any wiring. Size 3 and 4 full-voltage, non-reversing starters shall be drawout type after disconnecting power leads only. Starters over three-space units high may be bolt-on type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in deadfront openings in vertical power bus.

2. A suitable control disconnect device(s) to comply with the requirements of the NEC shall be provided.

3. Magnetic starters and contactors shall be electromagnetic vertical or horizontal lift design with double break cadmium oxide silver contacts. Design shall meet or exceed the requirements of UL and NEMA Standards. Coils shall be hot molded construction to protect the coils from mechanical and environmental damage.

4. Each starter shall be able to accommodate a minimum of three auxiliary contacts in addition to the hold-in contact.

5. Each starter shall be supplied with a 3-pole, manual reset overload relay. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered, have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy or bi-metallic type overload relays are not acceptable.

6. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid-state equipment (e.g., programmable logic controller) wired as part of the control circuit.

7. The Contractor and motor control center manufacturer is advised to review the Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings. Control power transformers shall be fused on both the primary and secondary sides. The minimum control power transformer VA requirements are shown below. Control power transformers shall be sized as required for the connected loads, plus 25% spare capacity.

    a. Size 1: 75 VA

    b. Size 2: 75 VA

c. Size 3: 200 VA

d. Size 4: 300 VA

e. Size 5: 500 VA

I. Circuit Breakers

1. Where specified herein, indicated on the Drawings, or required, the main circuit breaker(s) shall be rated for service entrance and bear a service entrance label.

2. Circuit breakers shall be UL 489 Listed molded case type with trip and frame ratings as indicated on the Drawings. Unless otherwise indicated, circuit breakers shall be manually operable, with automatic trip-free operation, and shall provide inverse-time-limit overload and instantaneous short-circuit protection. Where indicated on the Drawings, circuit breakers shall be 100% rated.

3. Unless indicated otherwise on the Drawings, circuit breakers shall be rated 480 VAC, 3-pole, and shall have 100-ampere or larger frames. The interrupting rating shall match that of the MCC short circuit rating at 480V.

4. Unless indicated otherwise on the Drawings, circuit breakers with smaller than 225-ampere frames shall be the thermal-magnetic type. Thermal and magnetic trip elements may be fixed or adjustable. Horizontally mounted operator handles for feeder circuit breaker units up to 225A are permissible if accepted in writing by the Engineer.

5. All circuit breakers with 225-ampere frames and larger, and smaller frame circuit breakers where specifically indicated on the Drawings, shall have interchangeable electronic trip units (ETUs) and adjustable trip elements and time delays. Provide electronic trip units with the adjustable functions indicated on the Drawings (e.g., Long, Short, Instantaneous, Ground).

6. The MCC manufacturer shall provide all of the proper lugs for all cable connections as required to avoid field modifications. Cable lugs for connecting to circuit breakers 1600A and larger shall be irreversible compression type; lugs for all smaller circuit breaker connections shall be mechanical type lugs. Reference the Drawings for the quantity and size of conductors.

7. For circuit breakers rated 1200A and larger, trip units shall be provided with a reduced energy let-thru mode to reduce arc-flash energy. Provide a lockable panel-mounted selector switch, normally open contacts, and a panel-mounted indicator light for control and indication of reduced energy let-thru mode. Provide all required appurtenances, factory wired, to enable the reduced energy let-thru feature.

8. Where indicated on the Drawings, shunt trip devices shall be provided to trip a circuit from a remote location by means of a trip coil energized from a separate circuit. A 120V shunt trip shall be capable of operating 55% or more of rated voltage. All other shunt trips shall be capable of operating at 75% or more of rated voltage.

J. Terminal Blocks

1. Terminal blocks associated with removable units within the motor control center shall be provided as follows:

   a. Terminal blocks shall be mounted within the unit insert and in the front for ease of accessibility.

   b. Pull-apart style terminal block assemblies shall be provided. Terminal block assembly shall consist of a male and female component held together with captive screws or positive retention clips. The terminal block assembly shall be designed to withstand the effects of vibration, yet able to be pulled apart without difficulty. The terminals of the assembly shall be recessed to isolate them from accidental contact. Terminal markings shall be provided for the purpose of identifying terminations. Terminal strips shall be suitable for use as a disconnecting means of foreign interlock voltages.

   c. For starters Size 2 and smaller, terminate all starter wiring (power and control) and external field wiring on terminal blocks provided in each unit.

   d. For starters Size 3 and larger, terminate control wiring and external field control wiring on terminal blocks provided in each unit.

2. Terminal blocks associated with non-removable units within the motor control center shall be provided in accordance with Section 26 09 16 – Electric Controls and Relays.

3. Provide a minimum of four spare terminals in each terminal block assembly.

K. Control Devices

1. Furnish and install control devices as required and/or shown on the Drawings. The following control devices shall be provided as specified in Section 26 09 16 – Electric Controls and Relays:

   a. Pilot devices (switches, indicating lights, etc.)

   b. Relays and timers

L. Nameplates

1. Provide engraved plastic nameplates to identify the motor control center, each unit compartment, door mounted devices, and internal components.

2. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems. Equipment names and numbers as indicated on the single line diagrams shall be used as the basis to engrave the nameplates.

3. Provide a master nameplate giving motor control center designation, voltage rating, ampere rating, short circuit rating, manufacturer's name, general order number and item number.

4. Control components mounted as part of the assembly, such as fuse blocks, control relays, pushbuttons, switches, and similar devices, shall be suitably marked for identification corresponding to appropriate designations on the manufacturer's wiring diagrams.

M. Future Space Requirements

1. Provide spaces for future combination starter and other units in the motor control centers. Furnish spaces with hardware to accommodate future plug-in control unit without modification of vertical sections. Provide the number of spaces required for future units as indicated on the Drawings, minimum.

2. Provide additional vertical sections to ensure total number of spaces as indicated on the Drawings. The number of vertical sections is contingent upon specific manufacturer's final proposed and Engineer-accepted configuration of motor control center units.

N. Motor Control Center Additions

1. The Contractor shall furnish and install complete motor control center sections or individual motor control center units to be added to existing motor control centers in accordance with these Specifications and as indicated on the Drawings.

2. These additions shall be of the same manufacturer, type, rating, and color as the existing motor control centers. Furnish and install all hardware necessary to connect the buses of the new and existing motor control centers, including ground buses. Enclosures shall match existing.

O. Motor Control Center Modifications

1. The Contractor shall modify existing motor control centers and specific motor control center units as specified herein and indicated on the Drawings. These modifications include, but are not limited to, additions of door mounted pilot devices, modifications to existing motor control circuits and other work.

P. Power Monitors

1. Where indicated on the Drawings, provide power monitors with door-mounted graphic display modules. Power monitors shall be PowerLogic ION7650 as manufactured by Square D Company, or EPM 9900P by Multilin. Power monitor manufacturer shall match the manufacturer of the other components of the MCC assembly. All PTs and CTs, power supplies, wiring, and other devices indicated on the Drawings, and as required, shall be provided for a complete monitoring system.

2. Power monitors shall be provided with sufficient on-board memory to store up to 50,000 user-defined event files and a network communications port to communicate with the control system via Ethernet/ TCP/IP protocol. Provide any necessary hardware gateways to provide this communication capability. The following parameters shall be communicated as a minimum:

   a. Current (all phases)

   b. Voltage (all phases)

   c. KW, KVAR, KVA

   d. Power Factor

Q. Surge Protective Devices

1. Surge protective devices (SPDs) shall be provided either integral to the MCC enclosure or as a separate unit external to the MCC enclosure, as indicated on the Drawings. See Section 26 43 13 – Surge Protective Devices for SPD requirements.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. The motor control centers shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. Install motor control centers to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of motor control center is installed next to a wall to the left of the motor control center section.

C. Where motor control center structures are located away from walls to allow bottom conduit entry, the Contractor shall furnish and install sheet metal coverings for openings along the sides and top of the motor control center line-up. The purpose of the coverings is to minimize dust, dirt, and undesirable materials from collecting behind the equipment.

The sheet metal coverings shall be of the same material, gauge, and finish as the motor control center.

D. Motor control centers shall be furnished with anchor bolts as required for aligning and mounting. Floor channels with end covers shall be of type recommended by the manufacturer and shall be furnished for installation in a concrete pad.

E. All field wiring that is terminated directly to a unit within the motor control center shall be neatly routed in a manner that does not hinder the ability to service, adjust, or replace components within that unit. Field wiring shall be properly anchored to the motor control center and individual unit structures.

F. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

**3.02 TESTING**

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

    a. None required.

2. Certified Shop Tests and Reports

    a. Submit description of proposed testing methods, procedures, and apparatus. Submit notarized and certified copies of all test reports.

    b. As a minimum, the entire motor control center shall go through a quality inspection before shipment. This inspection shall include, but is not limited to, the following:

        1) Physical inspection of the structure and the electrical conductors including bussing, general wiring, and units.

        2) General electrical tests including power circuit phasing, control circuit wiring, instrument transformers, meters, ground fault system, and device electrical operation.

        3) AC dielectric tests of the power circuits and control circuits.

        4) Markings/labels, including instructional type, UL, and inspector's stamps.

3. The manufacturer shall use integral quality control checks throughout the manufacturing process to maintain the correctness of the motor control center.

B. Field Tests

1. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

## 3.03 FIELD ADJUSTMENTS

A. All adjustable settings of circuit breakers shall be set in the field by the entity responsible for protective device setting and testing as specified in Section 26 05 00 – Basic Electrical Requirements, in accordance with the settings designated in the coordination study.

B. The settings of the motor circuit protectors and overload relays shall be developed and set by the entity responsible for protective device setting and testing as specified in Section 26 05 00 – Basic Electrical Requirements. The settings shall be in accordance with NEC requirements based on the motor nameplate data of the motors installed.

## 3.04 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified, factory-trained manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.

B. The manufacturer’s technical representative shall perform startup and functional testing of the equipment as specified herein.

C. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of 1 working day during the installation and startup of the equipment.

D. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

**END OF SECTION**

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## SECTION 26 27 26
## WIRING DEVICES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all switches, and receptacles as shown on the Drawings.

B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 26 05 33.16 – Boxes for Electrical Systems for outlet box requirements.

C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 19 – Low-Voltage Conductors and Cables.

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Wiring devices shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Fire Protection Association (NFPA):

    a. NFPA 70 – National Electrical Code (NEC).

2. Underwriters Laboratories (UL):

    a. UL 20 – General Use Snap Switches.

    b. UL 498 – Standard for Attachment Plugs and Receptacles.

    c. UL 943 – Ground Fault Circuit Interrupters.

    d. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

### 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

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## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

## 1.05 SPARE PARTS

A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## 1.06 IDENTIFICATION

A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall use the products of a single manufacturer for each type of wiring device.

C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:

1. Where the selected plate manufacturer does not manufacture a suitable finish plate.

2. For heavy-duty receptacles rated at more than 30A.

3. Where non-standard plates are required, specified, or shown.

D. The Contractor shall furnish and install all wiring devices and device plates.

E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.

F. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

## 2.02 WIRING DEVICES

A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double -pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed.

B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC and shall be UL 498 Listed. Receptacles shall be weather -resistant where installed in wet or damp locations.

C. Special purpose receptacles (e.g., welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.

D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC and shall be UL 943 Listed. Receptacles shall be weather -resistant where installed in wet or damp locations.

E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A.

F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.

G. Wiring devices shall be approved for use with stranded conductors if stranded conductors are to be used with the device. Reference Section 26 05 19 – Low-Voltage Conductors and Cable for conductor requirements

## 2.03 DEVICE PLATES

A. Device plates for indoor flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled

on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.

B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK-1VS-A, Crouse-Hinds #DS185, or Engineer approved equal for wall switches. Device plates for receptacles shall be “in-use” style, and shall be fully closable when a plug/cord is inserted. “In-use” weatherproof covers shall be rugged, minimum 3 ¼” depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or Engineer approved equal.

C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32 or Engineer approved equal for switches, and Crouse-Hinds DS23 or Engineer approved equal for receptacles.

## 2.04 PLUGS

A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

## 2.05 PROCESS INSTRUMENTS

A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument, etc.) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or Engineer approved equal. For hazardous locations, the device shall be UL 1203 Listed.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.

B. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and outlet boxes.

C. Wiring device box (outlet box) mounting heights shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.

E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault circuit interrupter (GFCI) type. GFCI receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.

F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14-point font.

## 3.02 CIRCUITING

A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

**END OF SECTION**

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# SECTION 26 28 16.16
# ENCLOSED SWITCHES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.

B. Disconnect switches for process instruments are not included in the scope of this Section and shall be as specified in Section 26 27 26 – Wiring Devices.

C. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 – Identification for Electrical Systems

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Disconnect switches shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Electrical Manufacturers Association (NEMA):

a. NEMA 250 – Enclosures for Electrical Equipment.

b. NEMA KS 1 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

2. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

3. Underwriters Laboratories (UL):

a. UL 98 – Enclosed and Dead-Front Switches.

b. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

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## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.

3. Assembled weight of each unit.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

## 1.05 SPARE PARTS

A. The equipment shall be furnished with all spare parts as recommended by the equipment manufacturer.

B. One complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Owner at the time of final inspection.

C. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

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## 1.06 IDENTIFICATION

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the equipment name with which it is associated (e.g., Final Effluent Water Pump No.1 DSW). Equipment identification shall be in accordance with Section 26 05 53 – Identification for Electrical Systems.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Switches shall be manufactured by the Square D Company, the GE by ABB, Rockwell Automation (Allen-Bradley), or Siemens Energy and Automation, Inc.

## 2.02 DISCONNECT SWITCHES

A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.

B. Disconnect switches for non-hazardous areas shall be UL 98 Listed. Disconnect switches for hazardous areas shall be UL 1203 Listed.

C. Switches shall meet NEMA Standard KS 1 type HD requirements, be, single-throw, be externally operated, and be fused or non-fused as indicated on the Drawings. Switches shall have the number of the poles, voltage, and ampere ratings as shown on the Drawings.

D. Enclosure Types and Materials

1. In non-hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Wet Process Area | NEMA 4X, Type 316 Stainless Steel |
| Indoor Dry Process Area | NEMA 12, Painted Steel |

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Dry Non-Process Area | NEMA 1, Painted Steel |
| Indoor Type 1 Chemical Storage/Transfer Area | NEMA 4X, Fiberglass |
| Indoor Type 2 Chemical Storage/Transfer Area | NEMA 4X, Type 316 Stainless Steel |
| All Outdoor Areas | NEMA 4X, Type 316 Stainless Steel |

2. In hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

| Area Classification | Enclosure Type and Material |
|---|---|
| Class I, Division 1, Group D | NEMA 7, Die Cast Aluminum |
| Class I, Division 2, Group D | NEMA 7, Die Cast Aluminum |
| Class II, Division 1, Group F | NEMA 9, Die Cast Aluminum |
| Class II, Division 2, Group F | NEMA 9, Die Cast Aluminum |

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

4. Where located outdoors or in indoor wet process areas, NEMA 7 and NEMA 9 enclosures shall also carry a NEMA 4X rating.

E. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.

F. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.

G. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides “finger-safe” protection when the door of the enclosed switch is open.

H. Disconnect switches shall be furnished with a manufacturer-supplied ground lug kit for termination of equipment grounding conductors. Where a grounded (neutral) conductor is shown on the Drawings in the conduits connected to the disconnect switch, a manufacturer-supplied neutral bar shall be furnished for termination of the grounded

conductors. Third party ground lug and neutral lug kits not supplied by the disconnect switch manufacturer are not acceptable.

I. Fused disconnect switches shall be furnished for motor operated valve and gate actuators where shown on the Drawings. The Contractor shall coordinate the supply of these fused switches with the specific requirements of the actuator. Fuses with fast fault clearing times may be required for modulating valve actuators.

J. Disconnect switches for all motors connected to variable frequency drives (VFDs) shall be furnished with a factory installed electrical interlock kit that includes one early-break auxiliary contact rated for 5A (minimum) at 120 VAC to be used to open the control circuit before the main switch blades break.

K. Disconnect switches for use on circuits utilizing shielded VFD cable(s), shielded submersible pump cable(s), or similar special cable constructions, shall be furnished with the configuration, accessories, and/or appurtenances necessary for use with such cables as described in Part 3 herein.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Disconnect switches shall be mounted, nominally, at 4 feet, 6 inches above finished floor or finished grade to the centerline of the operating handle mechanism (and not to exceed 6 feet, 7 inches to the center of the operating handle grip when in its highest position), at the equipment height where appropriate and permitted by the NEC, or where shown otherwise.

B. Disconnect switches shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

C. Where disconnect switches are shown on the Drawings to be installed on circuits utilizing shielded VFD cable(s), shielded submersible pump cable(s), or similar special cable constructions, the Contractor shall coordinate the configuration and installation of the disconnect switches with the switch manufacturer and respective cable and/or pump/equipment manufacturer(s). These types of cables require special methods to be utilized for termination, grounding, etc., and may also require the addition of isolated (from other ground conductors, enclosure/raceway grounding, etc.) ground/shield termination provisions in the disconnect switch for pass-through of the cable internal shield/ground conductor(s). Properly coordinating and executing the configuration and installation of disconnect switches with these cable types shall be the sole responsibility of the Contractor.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

**END OF SECTION**

## SECTION 26 29 23

## LOW-VOLTAGE VARIABLE FREQUENCY MOTOR CONTROLLERS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test and place in satisfactory operating condition all variable frequency drives (VFDs) as specified herein and indicated on the Drawings.

B. This Section does not stand by itself. The VFDs for the Final Effluent Water Pumps shall be coordinated and furnished with the driven equipment as specified in Section 43 25 13.10 - Wet Pit Submersible Solids-Handling Pumps. The pump manufacturer (supplier) shall have unit responsibility for the complete system comprising of the driven equipment and the VFD.

C. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 – Identification for Electrical Systems

3. Section 26 09 16 – Electric Controls and Relays

4. Section 26 43 13 – Surge Protective Devices

D. The Contractor is responsible for coordinating with the driven equipment manufacturer and the VFD manufacturer to ensure that the VFD is sized properly to meet all of the requirements herein. This includes, but is not limited to, accounting for motor rpm and variable or constant torque applications. The Contractor is responsible for including any costs related to equipment upsizing, conduit and wire upsizing, etc. that results from selecting equipment with a higher full load amp rating than was specified or used as the basis for design.

E. The VFDs shall be assembled using NEMA-rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

## 1.02 CODES AND STANDARDS

A. VFDs shall be designed, manufactured, and/or listed to the following standards as applicable:

1. IEEE 519 – Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

2. NEMA ICS 7 – Adjustable-Speed Drives

3. NEMA ICS 61800-2 – Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems

4. NEMA 250 – Enclosure for Electrical Equipment

5. UL 489 – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

6. UL 508A – Standard for Industrial Control Panels

7. UL 508C – Standard for Power Conversion Equipment

## 1.03 DEFINITIONS

A. The following definitions are provided for clarity with regard to the language used in this Section:

1. Variable Frequency Drive (VFD): The complete custom-engineered VFD as packaged within an overall enclosure, including the VFD unit and all other components within that enclosure as specified herein.

2. VFD Unit: The solid-state power electronic device or devices within the VFD.

## 1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in General Conditions and Section 01 30 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Reports of Certified Shop and Field Tests

5. Manufacturer’s Field Start-up Report

041322

6. Manufacturer’s Representative’s Installation Certification

7. Pre- Equipment-Selection Harmonic Study Report

## 1.05 PRE-EQUIPMENT-SELECTION HARMONIC STUDY

A. A comprehensive pre-equipment-selection harmonic study shall be prepared by the Contractor. The results of this pre-equipment selection study shall be submitted to the Engineer as part of the submittals specified herein. Should this study indicate the need for additional tuned filters, line reactors, isolation transformers, or other harmonic distortion suppression equipment, these shall be supplied and included in the Bid. Indicate the location of the harmonic suppression equipment in the submittal data. Location is subject to acceptance by the Engineer.

B. The harmonic distortion values resulting from operation of all or any VFD-driven motor-load combinations operating at full load shall be as defined in latest edition of IEEE Standard 519.

C. System single line diagrams and field access to the plant site will be provided to the Contractor for the purpose of providing this study. Contractor shall obtain from others other information that may be necessary to perform this study. Input data and other pertinent information used in harmonic study shall be coordinated by the Contractor with the following:

1. Input data/information/results of the short circuit fault analysis specified herein.

2. Electrical system configuration and electrical equipment shop drawing submittal data including, but not being limited to new non-linear loads, new linear loads, and new capacitors.

## 1.06 SHOP DRAWINGS

A. Shop drawings <u>for each VFD</u> shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this Specification Section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

2. Complete bill of material and catalog data sheets for all equipment and devices comprising the VFD.

3. Heat loss data for each VFD.

4. Manufacturer's warranty information.

5. Product data sheets for ALL system components, including but not limited to:

    a. VFD units

    b. RVSS units and motor overloads

    c. Harmonic correction devices and/or equipment, e.g. line reactors, passive filters, and 18-pulse phase-shifting transformers

    d. Output reactors and/or output filters

    e. Pilot lights and pilot devices

    f. Control and timing relays

    g. Enclosure fans

    h. Contactors

    i. Power supplies

    j. Control power transformers

    k. Current transformers

    l. Potential transformers

    m. Circuit breakers and/or motor circuit protectors

    n. Fuses

    o. Terminal blocks (power, control, and shorting)

    p. Surge protective devices

6. Layout drawings of the VFD that include:

    a. All cabinet or enclosure dimensions, access details, and weights.

    b. Required clearances around the enclosure, e.g. ventilation.

    c. Conduit entry areas and/or stub-up locations.

d. Nameplate sizes, colors, and locations.

e. Physical arrangement of door mounted devices located on the VFD enclosure.

f. Physical arrangement of ALL interior components, including DIN-rail-mounted devices.

General "catalog data sheet" layout drawings which are not specific to the systems specified herein are not acceptable.

7. Custom schematic and interconnection wiring diagrams of all electrical work, including but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, terminal blocks and identification numbers, wire numbers, and other equipment comprising the complete system.

   a. These drawings shall be circuit specific for each motor-load combination (e.g., Final Effluent Water Pumps). Specific equipment names consistent with the Drawings shall appear on each respective diagram.

   b. Indicate all devices, regardless of their physical location, on the schematic diagrams.

   c. Electrical ratings of all equipment and devices shall be clearly indicated on the schematic diagrams.

   Standard schematics and wiring diagrams that are not custom created by the manufacturer for the VFDs for this Project are not acceptable.

8. Confirmation of spare parts requirements as specified herein.

9. Table listing all motor loads connected to the VFD. Table shall include the full load amps of the APPROVED motors. Final approval of VFD shop drawings cannot be given until all motor loads for each VFD have been reviewed, approved, and shown in this table.

## 1.07 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions, Section 01 30 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions.

B. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each VFD. These final drawings shall be included in the O&M manuals and an additional copy that is plastic laminated shall be securely placed inside each VFD.

C. The O&M manual shall include the “as-commissioned” parameters of each VFD in both print and digital formats.

D. If the VFDs require computer software or configuration, the O&M manual shall include copies of all programming guides/manuals.

## 1.08 SPARE PARTS

A. The VFDs and accessories shall be furnished with all spare parts as recommended by the equipment manufacturer. In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts:

1. Two sets of fuses for each size and type of fuse provided.

2. One set of enclosure air filters for each VFD.

B. The spare parts shall be packed in containers suitable for long-term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.

D. Spare parts lists included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

## 1.09 WARRANTY

A. Contractor shall warrant that the material and workmanship of all components and the operation of the VFDs and auxiliary equipment is in accordance with the latest design practices and meets the requirements of this Section.

B. Warranty shall include, but not be limited to the following:

1. Replace components found to be faulty and make changes in equipment arrangement or make adjustments necessary to meet the equipment or functional requirements or this Section.

2. System rewiring and component substitution/rebuild.

3. All accessories and appurtenances provided by the VFD manufacturer.

C. Warranty shall be in effect for a period of 24 months following final acceptance of each VFD.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. The equipment covered by this Section is intended to be equipment of proven performance. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall obtain the VFDs from one manufacturer who shall also manufacture and assemble the enclosure and major equipment components including, but not limited to the VFD unit and bypass starters. The manufacturer shall have five years minimum of experience in the manufacture of similar units and shall have a general distribution to the electrical trade. Subcontracting of wiring and/or third-party assembly is not acceptable.

C. The VFDs shall be manufactured by the Square D Company, Rockwell Automation (Allen-Bradley), or ABB.

D. The Contractor shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all load, torque, speed and performance requirements from the appropriate sources and integrating these into a VFD that fulfills the requirements of this Section.

### 2.02 VFD SYSTEMS

A. Operating Conditions

1. The following operating conditions are applicable for all equipment of this Section.

a. Humidity: 0 to 95%

b. Ambient Temperature: 0 to 40 degrees Celsius

c. Altitude: Up to 3,300 feet

B. Basic Design and Performance

1. Each VFD shall be a complete alternating current electric drive system including all hardware and software necessary to accomplish variable speed operation of a motor and load combination. VFDs shall be provided in accordance with the requirements indicated on the Drawings and as described in these Specifications.

2. Each VFD shall be suitable for operation as part of a 480 VAC, 3-phase, 60 Hertz power distribution system. The complete VFD system shall have a minimum short circuit current rating of 65,000 amperes symmetrical at rated voltage, unless indicated otherwise on the Drawings.

3. The Contractor is fully responsible for the review of the full Contract Documents to determine specified motor speed, horsepower and full load ampere requirements for each motor-driven load. In addition, the Contractor shall size and select the VFD and components as follows:

   a. Each VFD shall provide, continuously, motor load current equal to 100% of the direct on-line motor nameplate full load current.

   b. Each VFD shall be selected for Variable Torque (Normal Duty) or Constant Torque (Heavy Duty) based on its respective load type served as shown in the following Load Type tables.

| Variable Torque (Normal Duty) Load Types | Constant Torque (Heavy Duty) Load Types |
|---|---|
| Wet Pit Submersible Solids-Handling Pumps | Screw Conveyors |

   c. The previous Load Type tables are intended to exhaustively cover all possible equipment controlled by VFDs to be provided under Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment and Division 46 – Water and Wastewater Equipment for this Contract. If a piece of equipment is found that is not explicitly listed in these tables, this discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution prior to submitting the Bid for this Contract.

4. Each VFD shall be suitable to operate, at times, on a limited power source engine-generator set. The VFD shall be provided with equipment and devices to prevent waveform distortion as specified herein.

5. Each VFD shall be provided with control and sequence logic as specified herein and indicated on the Drawings. Control and sequence logic shall be designed such that the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks. Each VFD shall be designed such that specific control and protection functions can be attained through simple programming by either factory engineers or Owner's trained operating personnel. In addition, refer to Section 40 61 96 – Process Control Descriptions, for a description of the operation of each VFD.

6. Unless otherwise accepted in writing by the Engineer, VFDs shall be provided with output reactors or filters to prevent elevated voltage levels at the motor terminals that exceed the ratings of the inverter duty rated motor winding insulation.

    a. The Contractor is responsible for providing the VFD manufacturer with estimated and field-verified cable lengths between each VFD and its respective motor. The VFD manufacturer shall select and size the output reactors or filters based on the cable lengths provided by the Contractor. Any change in output filter or reactor selection and/or size from the Bid shall be immediately brought to the attention of the Engineer in writing for resolution.

    b. The output filters or reactors shall be as manufactured by TCI, MTE Corporation, Mirus International, or engineer approved equal.

    c. **The Final Effluent Water Pump VFDs supplier is notified that the submersible pump motors will be located approximately 300 feet away from the associated VFDs**.

7. Motor control circuits shall be wired in accordance with the requirements specified herein and/or indicated on the Drawings.

C. Components

1. Each VFD shall contain the harmonic correction equipment as specified elsewhere in this Section.

2. Each VFD shall contain the number of auxiliary contacts, control power transformer(s), pilot devices and indicating lights, control relays, elapsed time meters, and other devices as specified herein, shown on the Drawings and required for the applications. The following components shall meet the requirements of Section 26 09 16 – Electrical Controls and Relays:

    a. Pilot devices (switches, indicating lights, etc.)

    b. Relays and timers

    c. Terminal blocks

3. Power terminal blocks for VFD output to the motor shall be fixed-mounted to a backplane or the enclosure. Mounting the terminal blocks on DIN rails is not acceptable.

4. Electrical bus, including ground bus, shall be tin-plated copper. Power and control wiring shall be copper, color coded and identified in accordance with these Specifications.

5. Each VFD shall be of modular construction allowing normal maintenance and repair to be done with ordinary hand tools. Design and install power electronic component assemblies so that, where practicable, components can be individually removed and replaced.

6. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100% redundant. New and unused spare replacement fan(s) or air conditioning unit(s), shipped in original carton, may be provided in lieu of 100% redundant auxiliaries if accepted in writing by the Engineer.

7. Circuit boards and electrical components shall meet the corrosion protection requirements specified in these Specifications. Varnished or epoxy encapsulated circuit boards and tropicalized contactors suitable for corrosive environments shall be furnished.

8. Motor Circuit Protectors

    a. Each VFD shall be protected by a motor circuit protector or circuit breaker that is UL 489 recognized.

    b. Motor circuit protectors shall be completely enclosed molded case devices with a current sensing coil in each of the three poles and have a magnetic trip adjustment located on the front. The motor circuit protector shall be manually operable. The protector shall be designed to meet the NEC requirement concerning motor full load and locked-rotor current. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes, consisting of metal grids mounted in an insulating support.

    c. The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break overcenter switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.

    d. Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic only element.

    e. Motor circuit protector ratings, modifications, etc., shall be as specified herein and as required for the VFD and motor load combination. Motor circuit protector or circuit breaker ratings shall be determined by the VFD manufacturer.

9. Circuit Breakers

    a. Unless otherwise indicated, circuit breakers shall be manually operable and shall provide thermal-magnetic, inverse-time-limit overload, and instantaneous short-circuit protection.

    b. Circuit breakers shall be molded case type, rated 480 VAC, 3 pole and have 100 ampere or larger frames. The interrupting rating shall match that of the VFD short circuit rating at 480V.

    c. Overload protection shall be provided on all poles with trip settings as indicated on the Drawings. Breakers of 225-ampere frames and larger shall have interchangeable solid-state electronic trip units.

    d. Where indicated on the Drawings, shunt trip devices shall be provided to trip a circuit from a remote location by means of a trip coil energized from a separate circuit. A 120V shunt trip shall be capable of operating at 55% or more of rated voltage. All other shunt trips shall be capable of operating at 75% or more of rated voltage.

10. The VFDs shall be provided with surge protective devices that meet the requirements of Section 26 43 13 – Surge Protection Devices.

11. Motor Protection Relays

    a. The VFDs for the large motors (400HP) shall be furnished with a motor protection relay with RTD inputs as specified elsewhere in this Section.

D. Controls

1. Each VFD shall be provided with automatic and manual controls as shown on the Drawings and as required to comply with all Specifications. Controls and indicators to accomplish operation and maintenance shall be located on the VFD equipment assembly as specified herein and indicated on the Drawings.

2. The Elementary Control Schematics shown on the Drawings are <u>REPRESENTATIVE OF DESIGN INTENT ONLY</u>. The manufacturer shall be responsible for providing all additional components, controls, and internal wiring necessary to meet the design intent.

3. VFD circuitry shall be designed such that the enclosure cooling fans only run when the VFD unit is producing output power. Designs that allow the enclosure cooling fans to run continuously when the VFD unit is energized but not producing output power are not acceptable. Fans that are used exclusively to provide cooling for the VFD unit (and not the overall enclosure) are permitted to run continuously if required by the VFD manufacturer’s design standards/practices.

E. Enclosures

1. Equipment within the VFD enclosure shall be arranged so that it does not interfere with the entry of conduits and cables into the enclosure.

2. All pilot devices (selector switches, pushbuttons, indicating lights, etc.) and the human machine interface (HMI, specified elsewhere herein) shall be door mounted on the exterior of each VFD enclosure. Manipulation of the pilot devices or HMI, viewing of the information on the HMI, or viewing that status of pilot devices shall not require the VFD enclosure door to be opened.

3. Unless otherwise indicated on the Drawings, VFDs in non-hazardous locations, shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Wet Process Area | NEMA 4X, Type 316 Stainless Steel |
| Indoor Dry Process Area | NEMA 12, Painted Steel |
| Indoor Dry Non-Process Area | NEMA 1, Painted Steel |
| All Outdoor Areas | NEMA 4X, Type 316 Stainless Steel |

4. VFDs shall not be installed in hazardous locations.

5. NEMA 1 and NEMA 12 VFD enclosures shall be force ventilated with front accessibility and the following:

   a. Enclosures shall be provided with washable enclosure air intake filters that can be replaced while the enclosure door remains closed.

   b. Enclosures shall be designed for bottom or top entry of conduits and cables as required.

   c. Enclosures shall be finished in ANSI-61 gray enamel or in a color to match the complete line-up of equipment as indicated on the Drawings and accepted by the Engineer.

6. NEMA 4X VFD enclosures shall be air conditioned, dead-front, with front accessibility and the following:

   a. The air conditioning system shall utilize a heat-exchange method that allows for cooling of the enclosure interior without circulating outside air through the enclosure.

b. Enclosures shall be furnished with tubular type enclosure space heaters. Space heaters shall be rated at 500V or 250V and operated at 240V or 120V, respectively.

c. VFDs shall be furnished with an additional control power transformer sized to provide power exclusively for the air conditioning system and enclosure space heater.

d. VFDs shall be furnished with a tamper-resistant hinged cover with a clear polycarbonate viewing window over the door-mounted pilot devices.

e. VFDs shall be designed for bottom entry of cables/conduits only.

7. Each VFD shall be designed such that rear access to the enclosure is not required for operations, maintenance, or repair tasks.

8. The Contractor shall reference the Drawings for maximum dimensions of the VFDs. No exceptions to the dimensions indicated on the Drawings will be permitted. The Engineer shall be notified prior to the initial shop drawing submittal if exceptions to the dimensions indicated on the Drawings are to be requested.

9. Integrating VFDs into a motor control center assembly is not permitted unless specifically shown as integrated on the Drawings.

10. Enclosure doors shall have full length piano type hinges and shall be braced to prevent sag when fully open.

11. Each VFD enclosure shall be supplied with an industrial, heavy-duty flange-mount handle mechanism for the operation of the VFDs disconnecting means as follows:

    a. The mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position.

    b. The operator handle shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator.

    c. It shall be possible to lock the handle in the "OFF" position with up to three 3/8-inch-diameter shackle padlocks and in the "ON" position with one 3/8-inch-diameter shackle padlock.

    d. The operator handle shall be mechanically interlocked such that the disconnecting means cannot be closed with the enclosure door open, nor can the enclosure door be opened when the disconnecting means is closed. A defeater mechanism shall be provided so that qualified personnel can bypass these interlocks for maintenance and testing purposes. The defeater

mechanism shall allow the enclosure door to be opened without interrupting the operation of the VFD.

F. Nameplates and Legend Plates

1. Provide engraved plastic nameplates and legend plates to identify each VFD and associated door mounted devices and internal components. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

2. Equipment names and/or numbers and device identification text shown on the Drawings shall be used as the basis to engrave the nameplates and legend plates. Where the equipment identification text would exceed the capacity of the VFD manufacturer’s standard nameplate/legend plate size, the manufacturer shall provide larger nameplates and/or additional nameplates as necessary. Abbreviating equipment names/numbers and device identification text is not acceptable.

3. Control components mounted as part of the assembly, such as fuse blocks, control relays, pushbuttons, switches, and similar devices, shall be suitably marked with identification corresponding to appropriate designations on the manufacturer's wiring diagrams.

## 2.03 VFD UNITS

A. The VFD unit shall be the Square D Altivar 600 series, Rockwell Automation (Allen-Bradley) PowerFlex 750 series, ABB ACS 800 series,.

B. Basic Design and Performance

1. Each VFD unit shall be of adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally programmable, and capable of precise and repeatable speed regulation of three phase 480 VAC NEMA Design A or B induction motors. Units for other than NEMA Design A or B induction motors (e.g., NEMA Design C) shall be coordinated with the requirements of that respective load.

2. Each VFD unit shall consist of a semiconductor rectifier system, direct current link, and pulse width modulated inverter. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the motor at the desired speed.

3. Each VFD unit shall operate the motor and produce full rated nameplate horsepower at the motor output shaft without exceeding motor nameplate full load current and with the motor not exceeding rated total temperature not including the

additional temperature increment that constitutes the motor service factor. Motor shall retain its service factor when operated by the VFD.

4. The overall efficiency of each VFD unit shall be a minimum of 95% when operating the specified motor-load combination at rated voltage, frequency, and current.

5. Each VFD unit shall provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed. The VFD unit shall be provided with adjustable maximum and minimum frequency limits.

6. Each VFD unit shall maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5% of rated frequency of 60 Hertz for a 24-hour period and a repeatability of 0.1% of rated frequency of 60 Hertz.

7. Each VFD unit shall be capable of operating the specified load continuously at any speed within the operating speed range of 10% to 100% of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The VFD shall provide for field adjustment of these setpoints.

8. Each VFD unit shall be capable of controlled linear acceleration and deceleration. Each VFD unit shall be capable of ramping the speed of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Each VFD unit shall have two field-adjustable speed setpoints for the VFD to skip equipment resonant frequencies. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.

9. Voltage or current unbalance between phases of the VFD unit output voltage shall not exceed 3% of the instantaneous values. The VFD unit shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3%. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.

10. Each VFD unit shall operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10% for a duration of 15 cycles. VFD unit output voltage regulation shall be plus or minus 2%.

C. Features and Characteristics

1. Each VFD unit shall be furnished with a Human Machine Interface (HMI) to provide controls and indication to accomplish maintenance and operational functions as specified herein and shown on the Drawings. The HMI shall be password

protected after startup to prevent unauthorized personnel from making changes. The HMI shall at minimum provide indication of the following:

a. Input Voltage

b. Output Voltage

c. Output Current

d. Output Frequency

e. Output Speed from 0-100%

f. Alarm Read-out

2. Each VFD unit shall provide a 4-20mADC output signal that is proportional to the drive output frequency for use as speed feedback/speed indication to external equipment.

3. Each VFD unit shall accept a 4-20mADC speed input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed equal to or less than 0.1% of rated speed.

   a. Where shown on the Drawings, VFD units shall also accept a 0-10VDC input from a speed potentiometer for manual speed control.

4. Input Voltage Loss Handling

   a. The VFD unit shall shut down upon a loss of one or more input phases, a 3-phase complete input power loss, or a sustained input undervoltage event. A sustained input undervoltage event is defined as voltage that is less 75% of nominal, for more than 0.5 seconds.

   b. Upon restoration of 3-phase power that is at an acceptable voltage level, the VFD unit shall automatically reset (after an adjustable time delay, 0 to 2 minutes) and be capable of being restarted and ramping up to speed when remotely commanded through the control system or locally commanded at any local controls. Personnel shall not be required to reset the VFD unit manually after a shutdown caused by any input voltage loss event.

   c. Automatic reset of the VFD unit shall be achieved through programming/parameter setpoints, time delay relays, or a combination of both.

5. Each VFD unit shall have a multiple attempt restart feature.

6. Each VFD unit shall have an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The VFD unit shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.

7. Each VFD unit shall be furnished with programmable electronic overload and torque limits.

8. Each VFD unit shall have an automatic trip feature which will remove the drive output from the motor and allow it to decelerate safely. This automatic system shall lock-out the VFD unit and indicate the fault only upon the following conditions:

    a. Output voltage unbalance (trip threshold field set).

    b. Loss of phase on output.

    c. Motor overload.

    d. Motor stator winding fault (phase-to-ground, phase-to-phase).

    e. Unacceptable voltage variation.

    f. High VFD equipment temperature.

    g. VFD failure as determined by the manufacturer.

    h. Component failure.

    i. Overcurrent.

9. Provide each VFD unit with transmitted and received radio interference protection. In addition, provide protection against starting a rotating motor, both directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the VFD unit, this feature shall be capable of being disabled.

10. Each VFD unit shall include on-line diagnostics, with an automatic self-check feature that will detect a VFD failure.

    a. Diagnostics shall operate a visual alarm indicator on the HMI.

    b. Diagnostics shall provide an easily readable output that can be used to isolate a failure.

    c. Provide an event and diagnostic recorder to printout in narrative English of the specific fault(s) and the sequence in which the faults occurred. An indication of the "First Out" failure is a minimum for fault sequence detection.

d. Provide normally open and/or normally closed dry contacts as indicated on the Drawings for VFD failure conditions.

11. Each VFD unit shall communicate the following parameters to the control system via Ethernet/IP protocol. Provide any necessary hardware gateways to provide this communication capability. The following parameters, at a minimum, shall be communicated:

    a. Motor current (all phases)

    b. Motor voltage (all phases)

    c. Motor KW

12. Each VFD unit shall be provided with input/output (I/O) cards including expansion cards as necessary to facilitate connection of all I/O specified herein and shown on the Drawings.

## 2.04 HARMONIC CORRECTION

A. Harmonic correction shall be provided for all VFD as specified as follows. The harmonic correction devices shall be included in the VFD enclosure.

B. Input Line Reactors

1. All 6-pulse VFD units shall be provided with input line reactor and/or integral DC link reactor. Total reactor impedance shall be a minimum of 3% and shall not exceed 5%.

C. Passive Harmonic Filters

1. All 6-pulse VFD units for motors rated 75HP and higher shall be furnished with a passive harmonic filter in addition to the integral DC link reactor previously specified herein (if present).

2. Passive harmonic filters shall be sized to attenuate harmonics resulting from operation of the VFD-driven motor load to no more than 5% THID when operating at full load, and no more than 8% THID when operating at 30% of full load. The filter shall be equipped with power contactors configured to remove the capacitors from the circuit when the VFD-driven loads are not in operation. The harmonic filters shall be as manufactured by TCI, MTE Corporation, Mirus International, or Engineer approved equal.

3. Passive filters shall be integrated into the VFD unless accepted in writing by the Engineer.

D. Active Front End (AFE) VFDs

1. AFE VFDs shall be acceptable in lieu of 6-pulse drives and integral passive harmonic filters specified in previous Paragraph C.

2. AFE VFDs shall be IGBT-based.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. The VFDs shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. Install VFDs to allow complete door swing required for component removal.

### 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

a. None required.

2. Certified Shop Tests and Reports

a. Submit description of proposed testing methods, procedures, and apparatus.

b. Factory test the complete VFD in accordance with IEEE and NEMA standards.

c. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

3. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA acceptance testing specifications referenced in Section 26 05 00 – Basic Electrical Requirements.

b. The Contractor shall field measure actual harmonic distortion with tests performed by an independent testing agency acceptable to the Owner after satisfactory full-load operation. The Contractor shall provide the harmonic distortion reports with the O&M Manual.

c. Unless otherwise indicated on the Drawings, the harmonic distortion measurements shall be made at each load center where VFDs are present.

d. Harmonic distortion measurements shall be made after VFD installation. One set of measurements shall be made with the VFD loads inactive, and one set of measurements shall be made with the VFD loads running at design capacity.

B. Acceptance of a shop test does not relieve Contractor from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the Contractor of responsibilities.

C. Certification on materials and records of shop tests necessary for the inspector to verify that the requirements of the Specifications are met, shall be made available to the inspector.

D. Submit signed and dated certification that all of the factory inspection and testing procedures described herein have been successfully performed by the Contractor prior to shipment.

## 3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and startup of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.

B. The manufacturer's technical representative shall perform all startup and field acceptance testing as specified herein.

C. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of 1 working day during installation of the motor controllers

2. One trip of 1 working day to perform startup and field acceptance testing of the motor controllers

D. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

## 3.04 PAINTING

A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

**END OF SECTION**

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## SECTION 26 41 00
## FACILITY LIGHTNING PROTECTION

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation a complete lightning protection system as specified herein. This is a performance specification. The Drawings do not show a complete lightning protection system design. The Contractor shall retain the services of a firm specializing in the design, installation, and testing of lightning protection systems.

B. Provide lightning protection system at the Thermal Dryer Facility building as noted on the Drawings.

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The system shall comply with the following codes and standards:

1. Underwriters Laboratories (UL)

    a. UL 96 – Lightning Protection Components

    b. UL 96A – Installation Requirements for Lightning Protection Systems

    c. UL 467 – Safety Grounding and Bonding Equipment

2. National Fire Protection Association (NFPA)

    a. NFPA 70 – NEC

    b. NFPA 780 – Standard for the Installation of Lightning Protection Systems

3. Lightning Protection Institute (LPI)

    a. LPI-175 – Standard for the Design – Installation – Inspection of Lightning Protection Systems

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## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Test Reports

5. UL Master Label Certification

## 1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings for each lightning protection system shall include, but not be limited to:

1. Product data sheets

2. Complete UL-approved, full size layout and installation drawings/details with clearly marked dimensions. Drawings shall indicate the exact location of all system components. Drawings shall be signed by a full-time employee of the lightning protection system manufacturer who is in responsible charge of this project and has been engaged in the business for at least 10 years.

3. Weights of all major components

4. Bill of material list for each lightning protection system

5. Manufacturer's installation instructions

6. Manufacturer's and installer's warranty information

7. Evidence of the designer/installers UL Listing

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and

similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## 1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01. The manuals shall include:

1. Instruction books and/or leaflets

2. Recommended spare parts list

3. Final as-built construction drawings included in the shop drawings incorporating all changes made during the installation.

4. All other information that was included in the shop drawing submittal

## 1.06 SPARE PARTS

A. The lightning protection system shall be furnished with all spare parts as recommended by the equipment manufacturer. In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following minimum spare parts for each structure provided with a lightning protection system under this Contract:

| Number Required | Descriptions |
|---|---|
| 2 | Air Terminals |
| 2 | Point Tip Protectors |

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The lightning protection systems covered by this Section shall be furnished using standard components of proven performance as manufactured by reputable concerns. The systems shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed.

B. System designer/supplier/installer qualifications shall be as follows:

1. System components shall be manufactured by a company specializing in lightning protection equipment with a minimum of 5 years of documented experience.

Company shall be Listed in the section entitled "Lightning Conductor, Air Terminals and Fittings" of the UL "Electrical Construction Materials Directory" for at least 5 years prior to this Contract's bid opening date.

2. The system designer/installer shall be an authorized installer of manufacturer with a minimum of 5 years of documented experience. Designer/Installer shall be Listed in the section entitled "Lightning Protection Installation" of the UL "Electrical Construction Materials Directory" for at least 5 years prior to this Contract's bid opening date.

## 2.02 LIGHTNING PROTECTION SYSTEMS

A. General

1. All components and parts of the lightning protection system shall be as specified herein. The materials used shall meet or exceed the material specification requirements of UL. All materials shall be marked with a UL Label or Stamp.

2. The complete lightning protection system shall be inspected and included in the Master Label certification.

B. Conductors

1. Conductors shall be aluminum cable, consisting of a minimum of 24 strands of No. 14 AWG aluminum wire. Copper conductors shall be furnished and installed only where required and when in contact with the earth. Where termination of copper conductors is required to aluminum parts, suitable bi-metallic connectors approved for the purpose shall be furnished and installed.

C. Fittings

1. Fittings shall be the bolted type with stainless steel bolts, nuts, and washers. Fittings shall be of cast metal construction specifically designed for the application. Crimp-type fittings are not acceptable. Bimetallic type fittings shall be furnished where required.

D. Fasteners

1. Fasteners shall be manufactured from non-corrosive material of ample strength and rigidity for the application.

E. Bases

1. Bases shall be bolted style provided with the model to suit the application (i.e., parapet, standing seam). Bolts, nuts, and washers shall be made of stainless steel. Bases shall be of aluminum or bronze construction, compatible with the

material of the surface to which it is attached. Crimp-type bases are not acceptable.

F. Ground Rods

1. Ground rods shall be 3/4-inch by 10-foot sectional type copper-clad steel rods as specified in Section 26 05 26 – Grounding and Bonding for Electrical Systems, quantity as required. Ground rods and all associated hardware shall be UL 467 Listed.

G. Air Terminals

1. Air terminals shall be solid aluminum. Air terminals shall be tapered or blunt tip type to suit the application and furnished with air terminal bases and safety tips (ball or bullet type) for impalement protection.

H. Thru-Roof Hardware

1. Thru-roof penetrations shall have stainless steel nuts, bolts, and washers. Sealing washers and sealing boots shall be provided as required and shall be compatible with the roofing material. Conductor connections to this roof hardware shall be by bolted connection. Crimp type connections are not acceptable.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. The lightning protection system shall be furnished and installed in accordance with the manufacturer's installation instructions. One copy of these instructions shall be included with the system components at time of shipment. The system components shall be suitably protected until accepted by the Owner.

B. The equipment shall be installed in accordance with the manufacturer's recommendations. Additional requirements shall include the following:

1. Course all main down conductors to maintain a downward or horizontal run free of pockets or sags. Maintain an 8" minimum radius and make no bend greater than 90 degrees. Follow the most direct route with inductance bonding conductors maintaining the horizontal or downward course of the main conductor. Interconnect roof conductors to provide at least two paths to ground from each terminal and to form closed loops. Follow the most direct path possible with down conductors between roof conductors and ground terminals. All down conductors for new occupiable buildings shall be placed in a concealed manner. Down conductors for existing occupiable structures, tanks, basins, and other non-occupiable structures may be installed exposed.

2. Install ground connections at no less than 60-foot intervals and at each down conductor on perimeter. If the structure has a ground grid, the ground rods from that grid may be used for connection to the down conductors. At each ground connection, determine the extent of the grounding arrangement according to the volume and type of soil encountered and the lowest expected moisture content. Have the Owner's representative observe each ground connection. Bond together all electrical service, telephone service, and lightning protection grounds to all underground metallic piping systems as required by Article 250 of the NEC.

3. The structural steel frame (where provided) may substitute for main down conductors provided the frame is electrically continuous and of adequate cross-section. Where the steel frame is utilized, connect the roof conductor to steel at least as often and at the same column as the ground connections. Make connections to steel with exothermic welds wherever possible. Provide bonding as required to make the entire metal frame continuous.

4. Bond all sizable metal objects within 6 feet of down, roof, or grounding conductors to the system. Use only approved fittings and conductors.

5. Wherever possible problems with corrosion are encountered, use substitute approved materials and/or provide corrosion protection. Use bimetallic or other specially designed and approved connectors where dissimilar metals are to be joined.

6. Install air terminals within 2 feet of the edge of structure and at intervals not greater than 20 feet along perimeter and peak. Provide additional terminals to limit spacing across roof to 50 feet maximum. Bond any exposed metallic object or surface to the roof conductor.

7. Air terminals shall not be installed for the following:

    a. On handrails or guardrails

    b. On the stems or stem covers of gates or valves

8. Handrails and/or guardrails that are at least 3/16 inch thick may be used as lightning strike devices. Bond handrail and guardrail sections as required to achieve the necessary electrical continuity for the installation.

9. All penetrations of conductors through the roof shall be made with thru-roof hardware as specified herein. Flash all thru-roof penetrations to conform to the roof manufacturer and installer’s requirements.

10. Every effort shall be made to avoid creating tripping hazards by not routing conductors across walkways on structures including but not limited to tanks,

basins, clarifiers, etc. If a conductor must be routed across a walkway, it shall be done in one of the following ways, creating a tripping hazard is not acceptable:

a. Concrete Walkways

1) Use a flat tinned-copper strip across the walkway that is anchored down at no less than 6-inch intervals along the length of the strip.

2) Embed a copper conductor in the walkway that is covered in no less than 2 inches of concrete embedment.

3) Install an aluminum conductor within a PVC Schedule 40 conduit, with the conduit embedded across the walkway covered in no less than 3-1/2 inches of concrete embedment.

b. Metallic Walkways

1) Install the conductor under the metal walkway support structure, with the conductor material being compatible with the metal it will be fastened to. Drilling holes in the metal support structure is not acceptable.

11. Record each ground connection location and mark up a reproducible copy of the approved shop drawings with their location. Also, indicate any substantial field modifications on these drawings. These drawings shall be included in the O&M manual.

12. Log all continuity tests of metal framing, ground grid connections, bonding, and similar connections. Indicate the location of tests or plans. Include test results in the O&M manual.

13. Retain UL to inspect the completed installation and issue a Master Label Certification. Furnish a copy of the Certification to the Owner upon receipt.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests and Reports

a. None Required

2. Field Tests

a. After installation, the lightning protection system shall be tested for continuity to the ground grid. The tests shall be made by the lightning protection system installer. Test shall be as follows:

1) Record the resistance between each down conductor and the ground grid to ensure a suitable low-resistance connection. All resistance values shall be 1 ohm or less. Test shall be made after the ground grid has been installed and tested per the requirements of Section 26 05 26 – Grounding and Bonding for Electrical Systems.

**END OF SECTION**

## SECTION 26 43 13
## SURGE PROTECTIVE DEVICES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation the surge protective devices (SPDs) as specified herein and indicated on the Drawings.

B. Reference the following Specification Sections:

1. Section 26 05 19 – Low-Voltage Conductors and Cables

2. Section 26 05 53 – Identification for Electrical Systems

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical & Electronic Engineers (IEEE)

a. C62.41.1 – IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits

b. C62.41.2 – IEEE Recommended Practice on Characterization of Surges in Low -Voltage (1000 V and less) AC Power Circuits

c. C62.45 – IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits

d. C62.62 – IEEE Standard Test Specifications for Surge -Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 V and less) AC Power Circuits

2. National Fire Protection Association (NFPA)

a. NFPA 70 – NEC

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3. UL

    a. UL 1283, latest edition – Electromagnetic Interference Filters

    b. UL 1449, latest edition – Surge Protective Devices

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

## 1.04 SHOP DRAWINGS

A. Drawings submitted by the manufacturer shall be complete and documented to provide the Owner with operations and maintenance capabilities.

B. Shop drawings for each SPD shall include but not be limited to:

1. Product Data Sheets

2. Detailed drawings showing weights and dimensions

3. Wiring diagrams showing field connections

4. Manufacturer’s Warranty Information

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

## 1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.

B. The Contractor shall furnish one spare field replacement module of each type and rating provided under this Contract if modules are field replaceable.

C. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## 1.07 IDENTIFICATION

A. Each SPD shall be identified by the circuit number and equipment name as indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each SPD. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

## 1.08 WARRANTY

A. All SPDs, associated hardware, and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a period of 10 years after acceptance of the equipment by the Owner.

B. Any component or subassembly contained within the surge protection system that shows evidence of failure or incorrect operation during the warranty period shall be replaced by the manufacturer at no additional cost to the Owner.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. The SPD units shall be UL 1449 Listed. Units that are “manufactured in accordance with” UL 1449 or “component recognized” SPDs are not acceptable and will be rejected.

B. Type II SPD units shall be UL 1283 Listed. Units that are “manufactured in accordance with” UL 1283 or “component recognized” SPDs are not acceptable and will be rejected.

## 2.02 PRODUCTS

A. Type I SPDs shall be furnished and installed when shown without upstream overcurrent protection on the Drawings. Type II SPDs shall be provided in all other locations. Type II SPDs shall not require the use of a specific upstream overcurrent device. SPDs shall be provided in the location and quantity as shown on the Drawings.

B. Each SPD shall be rated for the voltage and configuration of the equipment to which it is connected.

C. Each Type II SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.

D. The short circuit current rating of each SPD shall match or exceed the rating of the equipment to which it is connected. The Contractor shall reference the Drawings for short circuit current rating of each piece of equipment.

E. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

| System Configuration | Modes of Protection | Number of Modes |
|---|---|---|
| 3-Phase Wye | L-N, L-G, N-G | 7 |
| 3-Phase Delta | L-L, L-G | 6 |
| 3-Phase Impedance Grounded | L-L, L-G | 6 |
| Single-Phase | L-N, L-G, N-G | 3 |

F. Each SPD shall have a Maximum Continuous Operating Voltage (MCOV) of at least 115% of the nominal voltage of the equipment to which it is connected.

G. The Nominal Discharge Current (In) of each SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.

H. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

| System Voltage | L-N | L-G | L-L | N-G |
|---|---|---|---|---|
| 208Y/120 | 800V | 800V | 1200V | 800V |
| 480Y/277 | 1200V | 1200V | 1800V | 1200V |
| 480 DELTA | N/A | 1800V | 1800V | N/A |
| 240 DELTA | N/A | 1200V | 1200V | N/A |
| 120/240 | 800V | 800V | 1200V | 800V |

I. The surge current rating for each SPD shall be as indicated on the Drawings. Surge current ratings are indicated on single line diagrams and in panel schedules. Surge current rating indicated is on a per phase basis.

J. SPDs which are indicated to be installed externally mounted from the equipment that they protect shall be provided within a separate enclosure. The enclosure shall match or exceed the NEMA rating of the enclosure for the equipment that it is serving (e.g., NEMA1, NEMA 12, NEMA 4X).

K. Each SPD shall be provided with the following accessories:

1. Each individual module shall feature an LED indicating the individual module has all SPDs active. If any single component is taken off-line, the LED shall turn off and another LED shall illuminate, providing individual module as well as total system status indication.

2. Surge counter and audible alarm with reset/silence switch.

3. One set of Form C (SPDT) dry contacts rated for at least 5A at 120VAC.

L. SPDs which are indicated to be installed integral to (within) the equipment that they protect shall be manufactured by the same manufacturer as the equipment. SPDs which are indicated to be installed externally/separately mounted from the equipment that they serve shall be manufactured by ASCO/Emerson Network Power, Current Technologies, Square D, GE by ABB, or Siemens.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. The SPD units shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. SPDs which are indicated to be integral with the equipment that they protect shall be installed within the enclosure for that equipment.

C. Externally mounted SPDs shall be installed as follows:

1. The SPD units shall be mounted such that the conductor lengths are as short as possible, but no greater than 36 inches. Any installation resulting in a conductor length of greater than 36 inches shall be reviewed with the Engineer as a special type of cable may need to be installed. For equipment such as panelboards, the Contractor shall relocate the circuit breaker that is to be connected to the SPD as needed to achieve the shortest conductor length possible.

2. The Contractor shall use a close nipple to enclose the conductors between the SPD and the equipment served. However, if due to field conditions a 90-degree conduit bend is required to connect the SPD to the equipment that it serves, the bend shall have a minimum radius of 24 inches to eliminate any potential for sharp bends in the conductors.

3. Conductors between the equipment served and the SPD shall be 600V power wire and cable as specified in Section 26 05 19 – Low-Voltage Conductors and Cables. The individual phase conductors shall be gently twisted and all conductors shall be sized as indicated on the Drawings.

D. Prior to energizing, the following shall be performed for each SPD:

1. Verify that the SPD unit voltage and configuration is suitable for the system to which it is connected.

2. Verify that any neutral-to-ground bonding jumpers are installed as required.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Shop Tests

    a. Standard factory tests shall be performed on the equipment under this Section. All tests shall be in accordance with the latest version of NEMA, ANSI, and UL standards.

    b. All SPDs, subassemblies, and components shall be 100% tested and certified by the manufacturer to meet their published performance parameters.

2. Field Tests

    a. None required

**END OF SECTION**

# SECTION 26 50 00
# LIGHTING

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 26 – Grounding and Bonding for Electrical Systems

### 1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable.

1. Institute of Electrical and Electronic Engineers (IEEE)

   a. IEEE C62.41.3 – Guide for Surge Voltages in Low-Voltage AC Power Circuits

2. Illuminating Engineering Society (IES)

3. National Fire Protection Association (NFPA)

   a. NFPA 70 – National Electric Code (NEC)

4. Underwriters Laboratories (UL)

   a. UL 924 – Emergency Lighting and Power Equipment

   b. UL 844 – Luminaires for Use in Hazardous (Classified) Locations

   c. UL 916 – Standard for Energy Management Equipment

   d. UL 1012 – Standard for Safety Power Units Other Than Class 2

   e. UL 1598 – Luminaires

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## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts Lists

## 1.04 SHOP DRAWINGS

A. Shop drawings shall include but not be limited to:

1. Product data sheets

2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures

3. Photometric curves

4. LED data including efficiency (Efficacy lumens/watt) information

5. LED Driver information

6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens

7. Manufacturer’s warranty information

8. Custom wiring diagrams for each individual combination of lighting contactor and photocell used on this Project. Standard wiring diagrams that are not custom created by the manufacturer for the individual lighting contactors for this Project are not acceptable. One wiring diagram which is typical for all lighting contactors is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

9. System (entire fixture assembly) efficiency data

10. Pole and foundation calculations

B. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

C. Manufacturer's model/series and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a model/series describing the various types of fixtures shall be used as a guide only and does not exclude all the required accessories or hardware that may be required for a complete installation.

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

## 1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following additional spare parts shall be furnished:

1. A minimum of 1 LED driver for every 10 drivers (of the same type) installed

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

## 1.07 LIGHTING CONTROLS

A. The lighting systems shall be controlled as specified herein and indicated on the Drawings.

## 1.08 WARRANTY

A. The manufacturer's warranty shall in no event be for a period of less than 5 years from date of delivery of fixtures to the Project Site and shall include repair labor, travel expense necessary for repairs at the Project Site, shipping costs, expendables used during the course of repair, or complete replacement of the failed lighting unit.

B. Warranty shall be provided for the entire fixture and shall include all parts and accessories. Submittals received without written warranties as specified shall be rejected in their entirety.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be

designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The fixture schedule indicates the basis-of-design manufacturer(s) for each fixture type. The Contractor shall submit photometric calculations for each space and/or area where the Contractor wishes to use an equivalent fixture in accordance with Section 26 05 00 – Basic Electrical Requirements. Fixtures will be approved or denied as equivalent on a per-fixture and/or per-space/area basis.

## 2.02 FIXTURES

A. All lighting fixtures shall be furnished complete with all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all accessories, characteristics, and functionality as specified.

B. Fixture leads shall be as required by NEC. Fixtures shall be grounded by the equipment grounding conductor in the conduit.

C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.

D. Emergency and exit fixtures shall be UL 924 Listed and have a minimum 90-minute battery back-up.

E. Fixtures for use in hazardous locations shall be UL 844 Listed.

F. Fixtures specified to be damp or wet locations rated shall be UL 1598 Listed.

G. Fixtures shall be as specified in the Luminaire Schedule on the Drawings

## 2.03 LED DRIVERS

A. Drivers shall have a voltage range of 347-480V or 120-277 (as required) +/-10% at a frequency of 60 Hz.

B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.

C. Case temperature shall be rated for -40 through +80°C.

D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.

E. Drivers shall be furnished with a fused primary.

F. Drivers shall have an output current ripple <30%.

G. Drivers shall be manufactured by Philips, Advance, Universal or equal.

H. Drivers shall be UL Listed for damp location, UL1012, ROHS.

I. Drivers shall meet FCC 47 Sub Part 15.

J. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

## 2.04 LEDS

A. Luminaires provided with LED technology shall utilize high brightness LEDs with a group binning code of P and/or Q.

B. Color Temperature: as specified in fixture schedule.

C. Junction point shall be designed and manufactured to allow adequate heat dissipation.

D. LEDs shall be rated for 50,000 hours of life, minimum (based on IESNA L70).

## 2.05 POLES AND FOUNDATIONS

A. Poles shall be designed to withstand calculated wind force based on wind velocity in accordance with the provisions of the Building Code for the state of Georgia.

B. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. Poles shall have adequate handholes. Furnish and install weatherproof receptacles where indicated. All anchor bolts and nuts shall be hot-dipped galvanized steel.

C. The Contractor shall furnish and install a concrete foundation for freestanding pole mounted fixtures as indicated on the Drawings and as required (e.g., site/roadway lighting). The Contractor shall furnish and install structural anchorage/attachment, including mounting brackets where applicable, for pole mounted fixtures that are attached to a structure (e.g., clarifiers, aeration basins).

   1. Foundation shall be designed and approved by a Professional Structural Engineer currently licensed in the state of Georgia. The wind design shall be in accordance with ASCE 7 and the Building Code for the state of Georgia. Submit signed and sealed calculations for review.

D. Poles shall be as specified in the Pole Schedule on the Drawings:

## 2.06 LIGHTING CONTROLS

A. The lighting systems shall be controlled as specified herein and indicated on the Drawings

B. Photocells

1. Furnish and install photocells to control lighting fixtures as indicated in the Lighting Fixture Schedule on the Drawings.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Lighting fixtures shall be located symmetrically with building lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow "convenient" access for maintenance. The Contractor shall install fixtures at mounting heights indicated on the Drawings or as instructed by the Engineer. In areas with exposed ducts and/or piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer. Where fixtures are shown in locations on the Drawings where maintenance would be difficult, the Contractor shall notify the Engineer for direction.

B. The Contractor shall provide and install all inserts, conduit, structural supports as required, mounting, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.

C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Upon completion of work, and after the building area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, etc.

D. The Contractor shall furnish and install all pendant trapezes and pendant stem hangers with durable swivel or equivalent trapeze hanger permitting normal fixture motion and self-alignment. Fixture pendants shall be Appleton Type UNJ ball type flexible hanger at the fixture and supports from an Appleton JBLX junction box with JBLX hub cover, or equal. Pendant lengths shall be adequate and adjusted to provide uniformity of installation heights above the reference datum. Stems shall be one-piece, with matching canopies and fittings.

E. All wiring/cables associated with lighting equipment shall be installed in conduits or other raceways as specified. Installing wiring/cables exposed is not acceptable, unless specifically shown otherwise on the Drawings.

F. The Contractor shall furnish and install recessed fixtures with a separate junction box concealed and located as to be accessible when fixture is removed.

G. The Contractor shall furnish and install all boxes for lighting fixtures such that the box is not the sole support of the fixture. The boxes shall be offset to allow maintenance such that access to wiring within the box can be attained without having to consider supporting (holding) the fixture.

H. All lighting fixtures, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.

I. The Contractor shall support each fixture securely. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise, and shall not support fixtures from plaster. The Contractor shall furnish and install all members and supports as required to fasten and suspend fixtures from the structure.

J. In all mechanical equipment areas, the Contractor shall install lighting fixtures after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the Project Site during the course of the work.

K. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures as directed.

L. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools.

M. Lighting contactors shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

N. The Contractor shall commission astronomical time switch systems with input from the Engineer and Owner about on/off scheduling. The commissioning shall also include setup of the device’s geographic location and daylight savings time features.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests

    a. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

**END OF SECTION**

# SECTION 28 46 20
# FIRE ALARM SYSTEMS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish and install a complete addressable fire alarm system including control panel, annunciator, alarm initiating and indicating devices, conduit, wiring, and other components as required for a complete and operational system at the Thermal Dryer Facility building as shown on the Drawings.

B. System shall be in conformance with the latest NFPA and UL Standards listed as follows. Furnish installation drawings, tools, and all labor required to complete the work as specified herein and indicated on the Drawings.

C. This is a performance Specification Section. The Contractor shall hire a licensed Professional Engineer, certified in fire protection in the State of Georgia, to review the requirements of this Section and design a fire alarm system in accordance with all applicable standards and current Building Code of Cherokee County. The Contractor shall submit the Drawings to the local Authorities having jurisdiction as described herein and coordinate the approval process. The Contractor shall make any changes necessary and install any additional components required in order to receive approval, at no additional cost to the Owner. A fire alarm system design is not shown on the Drawings.

D. System shall be capable of being monitored by both a central station monitoring system as well as the Owner's local SCADA system. The system shall interface with the Wet Pipe Sprinklers system and Fluorine-Free Foam Fire Suppression System specified in Sections 21 13 13 and 21 13 24, respectively, as required.

E. The Contractor shall include in their bid all costs for the fire alarm system, including all of the necessary conduit, wire, supports, installation, etc.

F. Some components of the fire alarm system will be installed in NEC Article 501 hazardous areas. Reference Electrical Drawings for the extents of all hazardous areas.

G. All components used for the fire alarm system shall be suitable for the area in which they are installed. Fire alarm system design shall utilize appropriate components (e.g., weatherproof devices, explosion-proof devices) as required, even if required components are not specifically indicated within Part 2 – Products herein.

H. Reference Section 26 05 00 – Basic Electrical Requirements, Section 26 05 33.13 – Conduit for Electrical Systems, Section 26 05 19 – Low-Voltage Conductors and Cables, and Section 26 05 53 – Identification for Electrical Systems.

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## 1.02 CODES AND STANDARDS

A. The system shall comply with all Federal, State/Commonwealth, and County laws or ordinances, as well as all applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing as follows:

1. National Fire Protection Association (NFPA) Publications

a. NFPA 71

b. NFPA 72

c. NFPA 90A

d. NFPA 101

2. Underwriter’s Laboratories, Inc. (UL)

3. Factory Mutual (FM) System

4. NEC Article 760

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Division 01, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Manufacturer's Field Startup Report

5. Manufacturer's Representative's Certification

## 1.04 SHOP DRAWINGS

A. Shop drawings for each system shall include but not be limited to:

1. Control panel interior wiring diagrams, point-to-point wiring diagram showing the point of connection and terminal used for all electrical field connections in the system and field wiring color-coded scheme

2. Descriptive bulletins and product data sheets for all alarm indicating and initiating devices in sufficient detail to permit comparison with the specifications inclusive of:

manufacturer’s literature, illustrations, specifications, materials of construction, related engineering, data and compliance with NFPA, FM, UL, and local standards

3. A complete list identifying each addressable initiating device custom label, annunciator zone, notification appliance signaling zone, remote signaling and auxiliary function zone and the specific devices associated with each zone

4. An input/output matrix defining the system operation, which shall cross-reference each initiating device to its corresponding annunciator zones, notification appliance signaling zones, remote signaling zones and auxiliary function zones and indicate system operation in the event of each type of trouble condition recognized by the system. This matrix shall be in the format as shown in NFPA 72.

5. Power supply, standby battery, battery charger and NAC voltage drop calculations for each power supply, configuration of standby batteries in the system, identifying both the non-alarm and alarm load associated with each, and demonstrating conformance to the requirements of these specifications relative to sizing/capacity of power supplies, chargers, and standby batteries as applicable

6. Assembly and installation drawings

7. Spare parts list

8. Manufacturer’s warranty statement

9. Sample central station monitoring contract for Owner review

10. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this Specification Section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

B. Submit drawings, calculations and system component data sheets as listed in the previous paragraphs for approval to the City of Ball Ground, Cherokee County, Owner’s Insurance Underwriter, and any other Authorities Having Jurisdiction. Drawings and calculations shall be signed and sealed by a licensed Professional Engineer certified in fire protection in the state of Georgia.

C. Submit evidence that the equipment furnished complies with NFPA standards and satisfies all local codes for buildings in the appropriate Use Group as indicated on the building code sheets included in the Drawings.

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance manuals in accordance with the procedures and requirements set forth in Division 01. The manuals shall include:

1. Instruction books, descriptive bulletins, technical bulletins, application data booklets, and other applicable instructional information

2. Recommended spare parts list

3. Final as-built construction drawings included in the shop drawings incorporating all changes made during the completion of the Project

## 1.06 SPARE PARTS

A. The fire alarm system shall be furnished with all spare parts as recommended by the equipment manufacturer. Spare parts shall be furnished in accordance with Division 01.

B. In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following minimum spare parts:

| No. Required | Description |
|---|---|
| 5% (minimum of 1) | Each type of heat detector and smoke detector including base |
| 5% (minimum of 1) | Each type of manual pull station and each type notification appliance |

C. Spare parts shall be identical and interchangeable with corresponding parts of installed system.

## 1.07 IDENTIFICATION

A. Each system component shall be identified with a unique identification number. A nameplate shall be securely affixed in a conspicuous place on each device. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

B. Fire alarm terminal and junction boxes shall be identified in accordance with Article 760 of the NEC and painted red and stenciled “FIRE ALARM” preventing unintentional interference with the signaling circuits during testing, servicing and additional modifications to the system.

C. Major components of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address and type or style and catalog number of the item.

D. Keys and locks shall be furnished with tags bearing stamped identification numbers. Cable and conduit runs shall be identified in accordance with Section 26 05 33.13 – Conduit for Electrical Systems and Section 26 05 19 – Low-Voltage Conductors and Cables.

## 1.08 QUALIFICATIONS OF INSTALLER

A. Prior to installation, the Contractor shall submit data proving that they have successfully installed fire alarm systems of the same type and design as specified herein. Submit the names and locations of at least two installations where such systems have been installed. The Contractor shall indicate the type and design of these systems and certify that these systems have performed satisfactorily.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. To ensure that the fire alarm system is integrated, coordinated and compatible system, one manufacturer shall furnish all components specified herein. The system shall be as manufactured by Johnson Controls, Notifier by Honeywell, or Siemens Fire Safety.

## 2.02 FIRE ALARM SYSTEM

A. Fire Alarm Control Panel (FACP) and Fire Alarm Annunciator Panel (FAAP)

1. Provide a combination FACP and FAAP in the location shown on the drawings.

2. System shall be non-coded supervised addressable initiating, with annunciators as indicated on Drawings. Each circuit shall be electrically supervised against disarrangement. Wiring shall be Class A. Each system shall be able to be wired for a minimum of 250 addressable devices.

3. Control panel shall be microprocessor-based and use solid-state components to operate the system. Control panel shall contain a 60-hour, 24VDC battery back-up system. Provide system reset switch, battery and alarm horn, indicating device test switches and alarm relays.

4. Panel shall have the capability to accept as a minimum alarm initiating devices required by the fire alarm system design. In addition, the panel shall accept devices furnished per the HVAC system design, such as duct smoke detectors. The panel shall have a 1,000 point (minimum) capacity where one point equals one monitor (input) or one control (output).

5. Install auxiliary relays as required in the panel with a minimum of eight 120V normally open alarm contact outputs for remote alarm annunciation. The relays

shall energize when a fire alarm, trouble, or supervisory alarm occurs. Wire all relay contacts to terminal blocks for connection to field wiring.

6. In the event of total power loss and restoration, the status of the initiating devices and notification appliances shall remain unchanged. The entire fire alarm system shall be powered from the battery back-up system during a power loss.

7. The panel shall have a 24VDC power supply mounted in the panel enclosure.

8. The fire alarm system manufacturer shall provide all logic and/or programming to the control panel so the fire alarm system will operate as follows:

    a. When a fire alarm pull station is pulled, the fire alarm system will immediately go into an alarm state and energize the alarm horns, strobe lights and the auxiliary relays for remote notification

    b. The smoke detectors shall have an alarm verification feature to prevent nuisance alarms. In the event that a detector is activated and the alarm verification period has been exceeded, the fire alarm system shall go into an alarm state and energize the alarm horns, strobe lights and the auxiliary relay for remote notification.

9. The control panel shall also have all of the following features:

    a. Microprocessor based control

    b. Factory-programmed and field-configurable

    c. Alarm and trouble with 24-hour reminder

    d. Signal silence inhibit

    e. Alarm verification by device

    f. Alarm, trouble, supervisory and verification last event records

    g. One person test

    h. Inherently power limited per NEC Article 760

    i. UL-Listed

    j. FM-approved

    k. Dead front option for the enclosure

    l. Central station DACT and HVAC shutdown relays

m. Hardware for central station monitoring via analog telephone line

n. The control panel shall have voice annunciation capabilities. The control panel shall have a minimum of two pre-recorded messages that can be activated in the event of a fire or other evacuation of the building. Buttons shall be provided for maintenance personnel to activate the pre-recorded evacuation messages.

10. Alphanumeric Display and System Controls: Control panel shall include an LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

11. FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

12. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

13. Programmable Sensitivity: Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.

14. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be capable of being printed for annual recording and logging of the calibration maintenance schedule.

15. The FACP shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches predetermined values, three progressive levels of reporting shall be provided. The first level shall indicate if a sensor is close to a trouble reporting condition and shall be indicated on the FACP (i.e., "ALMOST DIRTY"). If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the FACP and subsequently a system trouble shall be reported. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If this indicator is ignored and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the FACP.

16. The FACP shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition at the FACP.

B. Alarm Initiating Devices

1. Fire Alarm Pull Stations

a. Fire alarm pull stations shall comply with NFPA standards and be compatible with the FACP.

b. Pull stations shall be double action addressable type that require an outer door to be operated to expose actuation handle.

c. Provide necessary control power, and any other modules required for operation integral with FACP.

d. Provide weatherproof pull stations in outdoor areas or indoor wet process locations. Provide pull stations suitable for use in hazardous areas when installed in hazardous areas.

2. Smoke Detectors

a. Smoke detectors shall comply with NFPA standards and shall be compatible with the FACP.

b. Type: Smoke sensors shall be of the photoelectric or combination photoelectric/ heat type.

c. Spacing: In accordance with the manufacturer's recommendations and the requirements of NFPA 72, however, in no case shall spacing exceed 30 ft. by 30 feet per detector.

d. Proximity to Fixtures: Smoke detectors shall not be placed closer than 5 ft. from any vent entrance or discharge point.

e. Each sensor base shall contain an LED that shall flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.

f. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.

g. Each sensor shall be scanned by the FACP for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a wrong device, the control unit shall operate with the installed device at the default alarm settings for that sensor. The settings shall be 2.5% obscuration for the photoelectric sensor, 135-degree F and 15-degree F rate-of-rise for

the heat sensor, and the FACP shall indicate a "Wrong Device" trouble condition.

h. The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI.

i. Plug-In Arrangement: Sensor and associated electronic components shall be mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the FACP.

j. Removal of the sensor head for cleaning shall not require the setting of addresses.

k. Provide detectors suitable for use in hazardous areas when installed in hazardous areas.

3. Duct Smoke Detectors

a. Duct smoke detectors shall have all the same features as a regular smoke detector except it shall be specifically designed to be installed in the supply or return ducts of the HVAC units where indicated on the HVAC Drawings. The detectors shall be rated for the size of duct in which it will be installed and the CFM of the air flow through it.

b. Location: Required where indicated on the HVAC Drawings and where required to meet all local and national codes.

c. Duct smoke detectors shall be furnished by the fire alarm system supplier under this Section but shall be installed by the HVAC Subcontractor.

d. The duct housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.

e. Duct housing shall provide a relay control trouble indicator yellow LED.

f. Duct housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of captive fastening screws.

g. Duct housing shall provide two test ports for measuring airflow and for testing. These ports shall allow aerosol injection in order to test the activation of the duct smoke sensor.

h. Each duct smoke sensor shall have a remote test station with an alarm LED and test switch.

4. Heat Detectors

a. Heat detectors shall comply with NFPA standards and shall be compatible with the FACP.

b. Spacing: In accordance with the manufacturer's recommendations and the requirements of NFPA 72.

c. Addressable heat detectors shall be ambient compensated combination rate-of-raise and fixed temperature type. The fixed temperature operation of the sensor shall be selectable for either 117 or 135°F. Rate-of-rise operation shall be selectable for either 15 or 20°F per minute and shall be self-restorable.

d. Heat detectors shall be addressable and shall be of the epoxy encapsulated electronic design. Detectors shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

e. Provide detectors suitable for use in hazardous areas when installed in hazardous areas.

5. Beam Detectors

a. Beam smoke detectors shall comply with NFPA standards and shall be compatible with the FACP.

b. Beam smoke detectors shall use advanced dual wavelength projected beams and imaging technology to determine the smoke obscuration at known locations, while providing a high resistance to false alarms and obstructions. The system shall consist of emitting (Emitters) and receiving (Imager) components for installation along the perimeter of the protected space.

c. Power for the smoke beam detector components shall be provided from the FACP.

d. The imager shall be provided with an on-board memory for diagnostics.

e. The beam detector shall be addressable to FACP.

6. The beam smoke detector system shall be OSID Smoke Detection by Xtralis or approved equal.

C. Alarm Indicating Devices

1. Fire Alarm Horns

a. Fire alarm horns shall comply with NFPA, UL Standards, all local codes and be compatible with the FACP.

b. Piezoelectric type horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 85 dBA@ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4-inch-square electrical box, without the use of special adapter or trim rings.

c. Provide horns suitable for use in hazardous areas when installed in hazardous areas.

2. Strobe Lights

a. Strobe lights shall comply with NFPA, UL standards, and the FACP.

b. Strobe lights shall have the words “FIRE” on it and comply with NFPA.

c. Strobe shall be listed to UL 1971. The strobe shall consist of a xenon flash tube and associated lens/reflector system. The strobe enclosure shall mount directly to standard single gang, double gang or 4-inch-square electrical box, without the use of special adapters or trim rings. strobe appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd and 110cd. Candela intensity shall be field adjustable. Provide an indicator inside the strobe lens to indicate the listed candela rating of the specific strobe appliance.

d. Provide units suitable for use in hazardous areas when installed in hazardous areas.

3. Audible/Visible Devices

a. Combination audible/visible (A/V) notification appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. A/V appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd and 110cd. Candela intensity shall be field adjustable. Provide an indicator inside the strobe lens to indicate the listed candela rating of the specific A/V appliance. The audible device shall meet the requirements of the audible devices previously described. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4-inch-square electrical box, without the use of special adapters or trim rings.

b. Provide units suitable for use in hazardous areas when installed in hazardous areas.

D. System Addressable Interface Devices

1. Control Module (Addressable Relay): The control modules shall be programmable by the FACP and installed where required. The control module shall be a line powered module and relay contact shall be capable of switching up to 2A@ 30 Vdc.

2. Monitor Module (Addressable Input): The monitor modules shall be installed where required and monitor normally open contacts and shall be programmed for a variety of input types as defined in the system programming.

E. Power Requirements

1. Power supply to all components of the system shall be as required, furnished and installed by the Contractor.

2. Booster power supplies shall be furnished and installed where required.

F. Fire Alarm Control Panel (FACP) Cellular Interface

1. The FACP Cellular Interface shall provide access to a Remote Supervising Station for monitoring of system alarms, troubles, and supervisory conditions as required and approved by the local AHJ and shall transmit those signals from the FACP over the digital cellular network to the designated monitoring station.

2. Unit shall meet UL 864 requirements for sole, primary, or backup path communications and shall support virtually all alarm formats for universal panel compatibility and shall serve as the sole communications path for the fire alarm system, replacing any of the landlines normally dedicated to the fire alarm control unit.

3. The unit shall provide multi-tower assessment to inform the installer if the unit can see multiple cell towers for redundancy. It shall also include SMS backup to reduce false alarms and provide self-tests using SMS if GPRS fails. Automatic self-tests of 5 minutes and daily with central monitoring station notification shall ensure the cellular system is operating and an available relay output for tripping the FACP when a trouble condition occurs shall be provided.

4. Power for the unit shall be via a UL listed plug-in transformer rated 12VAC, 800mA. Cellular transmit power shall be 1.0 to 2.0W and unit power consumption shall be 60mA standby and 250mA transmission. The radio transceiver shall be dual band cellular and PCS with GSM frequency and power of 850MHz: Class 4 (2 watts) and additional GSM frequency and power of 1900MHz: Class 1 (1 watt). Provide an externally mountable antenna. Antenna shall be 9-inch dipole with 2dBi

gain with 20 feet of cable and universal mounting bracket. Unit shall be registered under FCC part 15, 22, 24 and 68 compliant.

5. The unit shall be furnished in a wall-mounted, locking, red metal enclosure. Operating environment shall be 32 to 120°F; up to 95% humidity (non-condensing). An internal power supply with battery harness and backup batteries shall be provided. Two programmable supervisory trip outputs shall be provided with alarm format support for SIA2, Contact I D, pulse (3x1, 4x2), modem II e, & III a2, and DMP.

6. Unit shall be a TG-7FS as manufactured by Telguard or Engineer-approved equal.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. The fire alarm system shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions. One copy of these instructions shall be included with the equipment at time of shipment.

B. System and Control Wiring

1. All system wiring shall be furnished and installed by the Contractor. All wiring shall be installed in conduit in accordance with Section 26 05 33.13 – Conduit for Electrical Systems. System wiring shall be installed separate from all other building wiring.

2. All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, installed parallel and perpendicular to walls and partitions.

3. The sizes of the conductors shall be those specified by the manufacturer. Color coded wire shall be used. All wires shall be tagged at all junction points and shall be free from short circuits, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the FACP and the system field devices shall be made under the direct supervision of a factory trained representative.

4. All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the NEC, Article 725, and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72 latest edition.

5. The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the NEC.

C. Mount the FACP such that the height of the top operating handle or knob does not exceed 6 feet from the floor.

D. After completion of the installation, the Contractor shall clean the inside and the outside of the fire alarm system equipment and shall remove all dirt and debris from the site.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Requirements and Division 01. The following tests are required:

1. Witnessed Shop Tests

    a. None required

2. Certified Shop Tests and Reports

    a. Submit description of proposed testing methods, procedures, and apparatus.

    b. Submit certified copies of all factory test reports.

3. Field Tests

    a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and the requirements of all applicable codes and standards.

    b. Reference Section 26 05 00 – Basic Electrical Requirements.

    c. All tests shall be performed in the presence of the Engineer and Owner. The Contractor shall notify the Engineer at least 14 days before the performance and acceptance tests are to be conducted. A complete test report and letter of completion shall be submitted to the Engineer. The tests shall be performed by, or under the supervision of a qualified representative of the fire alarm system manufacturer and shall include the following:

        1) Verify that the system is free of grounds or open circuits. The FACP shall indicate when a ground or an open circuit exists.

        2) Verify that all alarm signal devices, stations, transmitters, automatic detectors, and supervisory devices are functioning as specified.

        3) Test each fire alarm device and circuit. Individually activate each manual initiating station and verify correct alarm operation and control panel response. Individually test each automatic initiating device and verify correct alarm operation, control panel response, and remote equipment operation.

4) Test battery backup systems for specified function and capacity.

d. The Contractor and the installer shall contact the local Building Department for final approval of the system and demonstrate the system to the Fire Department for approval.

e. If approval is denied by the Fire Department, then the installer shall make any changes necessary, at no additional cost to the Owner, to get approval as part of this scope. After any modifications have been made, if necessary, the installer shall demonstrate the system again to the Fire Department in order to get approval.

f. Coordinate testing of fire alarm system with fire suppression system testing.

g. Upon acceptance by the Owner, the completed system(s) shall be placed into service.

## 3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and startup of the equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.

B. The manufacturer’s technical representative shall perform all startup and field acceptance testing as specified herein.

C. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of 2 working days during installation of the fire alarm system

2. One trip of 2 working days to perform field acceptance testing of the fire alarm system

D. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

## 3.04 MANUFACTURER'S CERTIFICATION

A. A qualified, factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

**END OF SECTION**

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# SECTION 31 00 01
# EARTHWORK

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment, and materials required to complete all work associated with excavation (including off-site borrow excavation), fill and backfill placement and compaction, constructing embankments, dewatering, construction of drainage layers, installing foundation and backfill aggregate, placing filter and separation fabrics, stockpiling topsoil and any excess suitable material, designing, installing, maintaining and removing excavation support systems, disposing of all excess and unsuitable materials, providing erosion and sedimentation control, encasing utility conduits, site grading, preparation of pavement and structure subgrades, and other related and incidental work as required to complete the work shown on the Drawings and as specified herein.

1. The Owner will be responsible for payment for testing of soil materials and compaction by an independent Materials Testing Consultant (MTC). The Contractor shall be responsible for coordinating with this MTC as specified in Section 01 45 23 – Testing Services Furnished by Contractor.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

C. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

D. Earthwork performed under this Contract shall be done in conformance with these specifications. Items and activities not addressed herein shall be subject to the limitations of the latest editions of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems and Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems (hereinafter “GDOT Standard Specifications”). If there is a conflict between this Section and the GDOT Standard Specifications, the more conservative of the two shall take precedent.

E. Erosion and sedimentation control shall be performed in accordance with Section 31 25 00 – Erosion and Sedimentation Control of these specifications and with the latest edition of the Manual for Erosion and Sediment Control in Georgia (hereinafter the “Green Book”). If there is a conflict between this specification and the GSWCC “Green Book”, the more conservative of the two shall take precedent.

F. All fill materials (soil, aggregate, topsoil, etc.) imported to the site and onsite materials to be reused as fill, backfill, or embankment shall be subjected to the testing requirements contained in PART 3 of this Section. The Owner will retain a Materials Testing Consultant, who shall perform all testing. The test results shall be used to determine if a material meets the requirements included herein. The Contractor shall furnish all necessary samples for laboratory testing and shall provide assistance and cooperation during field tests. The Contractor shall plan their operations to allow adequate time for laboratory tests and to permit taking of field density tests during compaction.

G. Any costs for re-testing required as a result of failure to meet compaction requirements shall be borne solely by the Contractor.

## 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Divisions 01, 02, 31, and 32 of these Specifications.

## 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia Department of Transportation Standard Specifications Construction of Transportation Systems and Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems, latest edition (i.e., GDOT Standard Specifiations)

2. OSHA 29 CFR 1926 Subpart P

3. ASTM C127 – Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

4. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

5. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft$^3$ (600 kN-m/m$^3$))

6. ASTM D1140 – Standard Test Method for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing

7. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand Cone Method

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8. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/lb$^3$ (2,700 kN-m/m$^3$))

9. ASTM D1883 – Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils

10. ASTM D2216 – Test for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

11. ASTM D2487 – Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

12. ASTM D4253 – Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

13. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

14. ASTM D5268-22 – Standard Specification for Topsoil Used for Landscaping and Construction Purposes

15. ASTM D6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

16. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

## 1.04 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is referenced under Division 01 – General Requirements.

B. Attention is directed to the possible location of water pipes, sanitary pipes, storm drains, and other utilities located in the area of proposed excavation. In the event excavation activities disrupt service, the Contractor shall perform all repairs at no additional cost to the Owner. The Contractor shall contact georgia811.com or 1-800-282-7411 to request underground utility location mark-out at least 3 working days, not including the day the request is called in, but no more than 10 working days prior to the beginning of excavation. The Contractor shall also contact and request utility location mark-out from buried utility owners with utilities on the project site that are not participants of georgia811.com.

## 1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Name and location of all material suppliers

2. Certificate of compliance with the standards specified herein for each source of each material

3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites

4. Plans and cross sections of open cut excavations showing side slopes and limits of the excavation at grade

5. Proposed procedures for dewatering for review and approval prior to conducting any earthwork operations

6. Samples of synthetic filter fabric and reinforced plastic membrane with manufacturer's certificates or catalog cuts stating the mechanical and physical properties

    a. Samples shall be at least 1 foot wide and 4 feet long taken across the roll with the warp direction appropriately marked.

7. Construction drawings and structural calculations, signed and sealed by a Professional Engineer currently registered in the state of Georgia, for any types of excavation support required

8. Monitoring plan and pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems and near areas where dewatering is required to facilitate construction

9. A representative sample of the on-site or off-site source of each class of fill material weighing approximately 50 lbs delivered to a location designated by the Engineer

10. Plans of open cut excavation for review before approval is given to proceed

11. Excavation support installer qualifications with installation history

12. Drawings and calculations on proposed excavation support systems signed and sealed by a Professional Engineer currently registered in the state of Georgia.

13. Monitoring plan developed by the excavation support design engineer

14. Earthwork subcontractor qualifications

15. All required permits and a list of disposal sites for unsuitable materials within 30 consecutive days after Notice to Proceed. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.

16. Except where borrow is to be obtained from a commercial source, a borrow source development, use, and reclamation plan jointly developed by the Contractor and the property owner prior to engaging in any land disturbing activity on the proposed source (other than material sampling that may be necessary), including addressing the following:

    a. Drainage: The source shall be graded to drain such that no water will collect or stand and a functioning drainage system shall be provided. If drainage is not practical, and the source is to serve as a pond, the minimum average depth below the water table shall be 4 feet or the source graded so as to create wetlands as appropriate, or as agreed to with the property owner

    b. Slopes: The source shall be dressed and shaped in a continuous manner to contours which are comparable to and blend in with the adjacent topography, but in no case will slopes steeper than 3:1 be permitted.

    c. Erosion Control: Except where borrow is to be obtained from a commercial source, the Contractor and the property owner shall jointly submit a Borrow Source Development, Use, and Erosion Control Plan to the appropriate State or Local permitting authority for approval and provide evidence of such to the Engineer for their approval prior to engaging in any land disturbing activity on the proposed source other than material sampling that may be necessary.

## 1.06 PRODUCT HANDLING

A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the Work and shall be removed from the site.

## 1.07 USE OF EXPLOSIVES

A. The use of explosives will not be allowed for the prosecution of the Work.

## PART 2 – PRODUCTS

### 2.01 FILL MATERIALS

A. The Contractor shall be responsible for providing fill materials meeting the gradation requirements included herein.

B. All fill materials shall be free of organic material, environmental contaminants, snow, ice, frozen soil, or other unsuitable material.

C. Bedding material installed above and below the water table shall meet the requirements of the GDOT Standard Specifications.

D. Below-grade walls shall be backfilled with Select Fill.

E. When the excavated material from required excavations meets the requirements of Select Fill or Common Fill but is replaced with off-site borrow material for the Contractor's convenience, the costs associated with such work and material shall be borne by the Contractor.

F. Where excavated material does not meet requirements for Select Fill or Common Fill, the Contractor shall furnish off-site borrow material meeting the specified requirements herein. Determination of whether the borrow material will be paid for as an extra cost will be made based on the contract documents.

G. Contractor may stockpile excavated material to be used as Select Fill, Common Fill, Drainage Fill or Topsoil on site in areas designated in the Contract Documents. Soil materials may be stockpiled as necessary to sort, segregate, test, and transfer the materials. Excess material and materials considered unsuitable for reuse by the Engineer shall be removed from the site for off-site disposal. No stockpiling of excavated material is allowed in a manner or location that would permit erosion and its subsequent sedimentation in wetlands or other natural areas.

### 2.02 SELECT FILL

A. Select fill shall be used where shown on the Contract Drawings.

B. Select fill shall not include particles or lumps larger than 3 inches.

C. Select fill used as backfill against walls shall not contain any rock larger than 1-1/2 inches.

D. Select fill shall consist of non-plastic materials classifying as SM, ML, CL, SW, SP, SC, SP-SM, or SP-SC per ASTM D2487. Select fill shall be free of organic material, environmental contaminants, waste construction debris, snow, ice, frozen soil, or other unsuitable material.

E. Open-graded and dense-graded GDOT aggregates meeting the previous gradation requirements may be used as Select Fill.

F. Select Fill to be used as pavement subbase material shall be GDOT Graded Aggregate Base (GAB).

G. Select Fill shall be placed in 8-inch-thick lifts, with the exception of GDOT No. 57 aggregate, which may be placed in 12-inch-thick lifts.

H. Select Fill shall be compacted to not less than 95 percent of the maximum dry density obtainable by ASTM D698 and does not contain unsuitable material.

I. The upper 12 inches of pavement subgrades shall be compacted in accordance with Georgia DOT requirements to at least 100 percent of maximum dry density by ASTM D698.

J. Select Fill shall be compacted at a moisture content within 20 percent of the optimum moisture content of the fill material in accordance with the ASTM D698, Standard Proctor.

K. All materials used as Select Fill are subject to approval by the Engineer.

**2.03 DRAINAGE FILL**

A. Drainage Fill shall be used where shown on the Contract Drawings.

B. Drainage Fill shall consist of GDOT No. 57 aggregate.

**2.04 COMMON FILL**

A. Common Fill shall be used where shown on the Contract Drawings.

B. Common Fill shall consist of non-organic on-site soils classifying as SC, SM, and ML material that is free from rocks larger than 3-inch in diameter, ashes, cinders, refuse, organic material, frozen soil, and other deleterious material.

C. Material containing more than 10-percent gravel, stones, or shale particles is not acceptable.

D. Common Fill shall be placed in 8-inch-thick loose lifts.

E. Common Fill shall be compacted to not less than 95 percent of the maximum dry density obtainable by ASTM D698 and does not contain unsuitable material.

F. Common Fill shall be compacted at a moisture content within 20 percent of the optimum moisture content of the fill material in accordance with the ASTM D698, Standard Proctor.

G. All material used as common fill is subject to approval by the Engineer. If there is insufficient suitable material onsite, import whatever additional material is required which conforms to the specifications, at no additional cost to the Owner.

H. Select Fill may be used as Common Fill, subject to approval by the Engineer. Select fill may be used as Common Fill at no change in the Contract Price.

## 2.05 TOPSOIL

A. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, clay loam). It shall be free of debris, trash, stumps, rocks, roots, and noxious weeds, and shall give evidence of being able to support health vegetation. It shall contain no substance potentially toxic to plant growth. All topsoil shall be tested by a recognized laboratory for the following criteria: Organic matter content shall not be less than 1.5% by weight. pH range shall be from 6.0 -7.5. If pH is less than 6.0, lime shall be added in accordance with test results or in accordance with the recommendations of the vegetative establishment practice being used. Soluble salts shall not exceed 500 ppm. If additional topsoil is needed, it must meet the standards stated above.

## 2.06 GEOTEXTILES

A. The Contractor shall provide geotextiles as indicated on the Contract Drawings and specified herein. The materials and placement shall be as indicated under Section 31 05 19 – Geotextiles.

# PART 3 – EXECUTION

## 3.01 STRIPPING OF TOPSOIL

A. In all areas to be excavated, filled, or paved, the topsoil shall be stripped to its full depth.

B. Topsoil may be stockpiled for subsequent reuse on site at locations shown on the Contract Drawings or designated by the Owner or Engineer. Topsoil shall be kept separated from other excavated materials and shall be piled free of roots and other undesirable materials. Topsoil shall not be stored in areas where it will interfere with surface drainage or with the conservation of trees, shrubs, and other vegetation to remain. No stockpile shall be placed within 50 feet of a pond, stream, wetland, or stormwater inlet.

## 3.02 EXCAVATION

A. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED EXCAVATION. Excavation shall include the removal of all soil, rock, weathered rock, rocks of all types, boulders, conduits, pipe, all other obstacles encountered, and all other obstacles shown to be removed within the limits of excavation shown on the Contract Drawings or specified herein. The cost of excavation shall be

included in the Lump Sum Bid Price and no additional payment will be made for the removal of obstacles encountered within the excavation limits shown on the Drawings and specified herein.

B. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Engineer. No excavation shall be wasted except as may be permitted by the Engineer. Refer to the drawings for specific location and placement of suitable excavated materials in the formation of embankments, backfill, and structural and roadway foundations. THE ENGINEER AND/OR MATERIALS TESTING CONSULTANT WILL DESIGNATE MATERIALS THAT ARE UNSUITABLE. The Contractor shall furnish off-site disposal areas for the unsuitable material. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Contractor shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer and/or materials testing consultant such measures are necessary to provide proper construction.

C. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.

D. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas. Excavation requirements and slopes shall be as indicated in the Drawings.

E. The Contractor shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from slopes.

F. It is the intent of these Specifications that all structures shall bear on an aggregate base, crushed stone or screened gravel bedding placed to the thickness shown on the Drawings, specified in these Specifications, or not less than 6 inches. Bedding for process piping shall be as specified in Section 40 05 00 – Basic Mechanical Requirements, or as shown on the Drawings.

G. The bottom of all excavations for structures and pipes shall be examined by the Engineer and/or materials testing consultant for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer and/or materials testing consultant, additional excavation is required due to the low bearing value of the subgrade material, or if the in place soils are soft, yielding, pumping or wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, and/or crushed stone or screened gravel as indicated by the Engineer. Payment for such additional work ordered by the Engineer will be made as an extra by a Change Order in accordance with the General Conditions, as modified by the Supplementary Conditions, and Division 01 – General Requirements. No payment will be made for subgrade disturbance caused by inadequate dewatering or improper construction methods.

H. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.

I. Slides and over-breaks which occur due to negligence, carelessness or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as indicated by the Engineer at no additional cost to the Owner. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.

J. Where the excavation exposes sludge, sludge contaminated soil or other odorous materials, the Contractor shall cover such material at the end of each workday with a minimum of 6 inches and a maximum of 24 inches of Common Fill. The work shall be an odor abatement measure and the material shall be placed to the depth deemed satisfactory by the Engineer for this purpose.

## 3.03 EXCAVATION SUPPORT

A. The Contractor shall furnish, place, and maintain such excavation support which may be required to provide safe working conditions and support sides of excavation or to protect structures, pipes, and utilities from possible damage. The Contractor shall be exclusively responsible for maintaining safe working conditions and structure integrity without overstressing or damaging existing structures, pipes, and utilities resulting from the Contractor temporarily placing, moving, or removing loads on or adjacent to existing structures, pipes, and utilities. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, the Engineer may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing the support system.

B. The selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor. Contractor shall submit drawings and calculations to

the Engineer on the proposed systems sealed by a Professional Engineer currently registered in the in the state of Georgia.

C. The excavation support system shall be installed by a specialized contactor with a minimum of 5 years' experience installing the type of excavation support system proposed.

D. The Contractor shall exercise caution in the installation and removal of supports to ensure no excessive or unusual loadings or vibrations are transmitted to any new or existing structure. The Contractor shall promptly repair at their expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.

E. Contractor shall monitor movement and vibration in the excavation support systems as well as movement and vibration at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. The Contractor shall be exclusively responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of their operations.

F. All excavation supports shall be removed upon completion of the Work except as indicated herein. The Engineer may permit supports to be left in place at the request and expense of the Contractor. The Engineer may order certain supports left permanently in place in addition to that required by the Contract. The cost of the materials so ordered left in place, less a reasonable amount for the eliminated expense of the removal work omitted, will be paid as an extra by a Change Order in accordance with the General Conditions, as modified by the Supplementary Conditions and Division 01 – General Requirements. Vibrations of new and existing structures shall be considered when the Contractor decides whether to remove excavation supports or leave them in place. Any excavation supports left in place shall be cut off at least 2 feet below the finished ground surface or as directed by the Engineer.

## 3.04 PROTECTION OF SUBGRADE

A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:

1. Use of heavy rubber tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the

excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.

2. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.

3. The Contractor shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

## 3.05 PROOF-ROLLING

A. The subgrade of all structures and all areas that will support pavements or select fill shall be proof-rolled. After stripping of topsoil, excavation to subgrade and prior to placement of fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proof-rolled with a heavily loaded tandem-wheeled dump truck to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material, as directed by the Materials Consultant.

## 3.06 DEWATERING

A. The Contractor shall do all dewatering as required for the completion of the Work. Procedures for dewatering proposed by the Contractor shall be submitted to the Engineer for review prior to any earthwork operations.

B. All water removed by dewatering operations shall be disposed of in accordance with the Georgia Erosion and Sedimentation Act.

C. The dewatering system shall be of sufficient size and capacity as required to control groundwater or seepage to permit proper excavation operations, embankment construction and reconstruction, subgrade preparation, and to allow concrete to be placed in a dry condition. The system shall include a sump system or other equipment, appurtenances and other related earthwork necessary for the required control of water. The Contractor shall draw down groundwater to at least 2 feet below the bottom of excavations (subgrade), over the entire excavation area, at all times in order to maintain a dry and undisturbed condition.

D. The Contractor shall control, by acceptable means, all water regardless of source. Water shall be controlled, and its disposal provided for at each berm, structure, etc. The entire periphery of the excavation areas shall be ditched and diked to prevent water from entering the excavation. The Contractor shall be fully responsible for disposal of the water and shall provide all necessary means at no additional expense to the Owner. The

Contractor shall be solely responsible for proper design, installation, proper operation, maintenance, and any failure of any component of the system.

E. The Contractor shall be responsible for and shall repair without cost to the Owner, any damage to work in place and the excavation, including damage to the bottom due to heave and including removal of material and pumping out of the excavated area. The Contractor shall be responsible for damages to any other area or structure caused by their failure to maintain and operate the dewatering system proposed and installed by the Contractor.

F. The Contractor shall be responsible for and shall repair, without cost to the Owner, any damage to work in place and nearby structures, roadways, and utilities which can be reasonably attributed to dewatering operations. This includes settlement of structures, roadways, and utilities due to dewatering of soils supporting the structures, roadways, and utilities.

G. The Contractor shall take all the steps that they consider necessary to familiarize himself with the surface and subsurface site conditions, and shall obtain the data that is required to analyze the water and soil environment at the site and to assure that the materials used for the dewatering systems will not erode, deteriorate, or clog to the extent that the dewatering systems will not perform properly during the period of dewatering. Copies of logs of borings and laboratory test results are available to the Contractor. This data is furnished for information only, and it is expressly understood that the Owner and Engineer will not be held responsible for any interpretations or conclusions drawn therefrom by the Contractor.

H. Prior to the execution of the Work, the Contractor, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

## 3.07 FILL OR EMBANKMENTS

A. Contractor shall perform the construction of fill or embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.

B. Subgrades upon which fill or embankments are to be constructed shall be stripped of topsoil, organic material, rubbish and other extraneous materials. After stripping and prior to placing fill or embankment material, the Contractor shall compact the top 12 inches of in-place soil as specified under Article 3.09 COMPACTION.

C. Any soft or unsuitable materials revealed before or during placement fill or embankment placement shall be removed as indicated by the Engineer and/or materials testing consultant and replaced with select fill and compacted as required.

D. Fill subgrades on which fill or embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the embankment with the existing surface. The fill or embankment soils shall be as specified under Part 2 - Products, and shall be deposited and spread in successive, uniform, approximately horizontal layers. The loose thickness of each lift shall not exceed the thickness for each fill type noted in Article 3.09 COMPACTION.

E. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. Fill or embankment subgrades shall be properly drained at all times and kept free of flowing or ponding water, snow, ice and frozen soils. Saturated soils, snow, ice, or frozen soils shall be removed as recommended by the Engineer.

F. Each layer of the embankment shall be thoroughly compacted to the density specified under Article 3.09 COMPACTION.

G. The embankment or fill material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Moisture conditions and manipulation of the fill or embankment material, when necessary, shall be performed to maintain a uniform moisture content throughout the layer. Should the material be too wet or too dry to permit proper compaction, earthwork operations shall be delayed until the material is adequately moisture conditioned. Samples of all fill or embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.

H. Where fill or embankments materials are to be placed and compacted on sloped subgrades steeper than 4:1 shall be benched. Benches shall be at least 6 feet wide.

I. When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankments and the other material which meets the requirements for select fill shall be incorporated into the formation of the embankments. Stones or fragmentary rock larger than 4 inches in their greatest dimension will not be allowed within the top 6 inches of the final grade. Stones, fragmentary rock, or boulders larger than 12 inches in their greatest dimension will not be allowed in any portions of embankments and shall be disposed of by the Contractor as indicated by the Engineer. When rock fragments or stone are used in embankments, the material shall be brought up in layers as specified or directed and every effort shall be exerted to fill the voids with finer material to form a dense, compact mass which meets the densities specified for embankment compaction.

## 3.08 BACKFILLING

A. All structures and pipes shall be backfilled with the type of materials shown on the Drawings and specified herein. Fill placed as structure or utility backfill shall be

deposited in successive, uniform, approximately horizontal lifts. The thickness of each lift shall not exceed the requirements of Article 3.09 COMPACTION.

B. Each lift of fill placed backfill shall be thoroughly compacted to the density specified for each type of fill included in Article 3.09 COMPACTION.

C. Where excavation support is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that supports will be installed in similar soil conditions or employ other appropriate means to prevent loss of support.

D. Backfill against concrete or masonry structure shall not be performed until the associated work has been reviewed and backfilling permitted. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength or earlier at the discretion of the Engineer. Partial backfilling against adequately braced wall may be considered by the Engineer on an individual situation basis. Where walls are to be waterproofed, all work shall be completed and membrane materials dried or cured according to the manufacturer's instructions before backfilling.

E. Backfill against tanks and other structures which are to retain liquids shall not be performed until leakage tests are completed and accepted by the Engineer in accordance with Section 01 88 16 – Watertightness Testing of Concrete Structures.

## 3.09 COMPACTION

A. The Contractor shall compact embankments, backfill, crushed stone, aggregate base, and in place subgrade in accordance with the requirements of this Section. The densities specified herein refer to percentages of maximum density as determined by the noted test methods. Compaction of materials on the project shall be in accordance with the following schedule:

| | Density % Standard Proctor (ASTM D698) | Density % Mod. Proctor (ASTM D1557) | Max. Lift Thickness as Compacted Inches |
|---|---|---|---|
| Embankments Beneath Structures, Roadways, and Sidewalks* | 98 | 92 | 8 |
| Common Fill Areas | 95 | 90 | 8 |
| Backfill Around Structures | 95 | 90 | 8 |
| Backfill in Pipe Trenches | 95 | 90 | 8 |

| | Density % Standard Proctor (ASTM D698) | Density % Mod. Proctor (ASTM D1557) | Max. Lift Thickness as Compacted Inches |
|---|---|---|---|
| Crushed Stone Beneath Structures | ** | ** | 12 |
| Select Sand | 98 | 92 | 8 |
| Graded Aggregate Base (GAB) Beneath Structures, Roadways, and Sidewalks | ** | 98 | 8 |
| Crushed Stone Backfill | ** | ** | 12 |
| Crushed Stone Pipe Bedding | ** | ** | 12 |
| In Place Subgrade Beneath Structures, Roadways, and Sidewalks | 98 | 92 | Top 12 inches |

* Embankments beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope.
** The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

B. Compaction Near Existing Structures

1. Vibratory equipment shall not be used with 25 feet of any existing structure.

2. Within 25 feet of any existing structure, non-vibratory compaction equipment such as a drum roller with a maximum weight of 4 tons should be used. Within 5 feet of any existing structure, a walk behind vibratory sled or roller shall be used.

C. Field density tests will be made by the Materials Testing Consultant to determine if the specified densities have been achieved, and these tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D1556, ASTM D1557, or ASTM D6938. The Engineer, in conjunction with the Materials Testing Consultant, will be the judge as to which test method will be the most appropriate. Failure to achieve the specified densities shall require the Contractor to recompact the material or remove it as required. The Contractor shall, if necessary, increase the compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the thickness of the layers. The Contractor shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.

D. Testing will be performed as frequently as deemed necessary by the Engineer and/or Materials Testing Consultant. As a minimum, one in place density test shall be performed for each 1000 cubic yards of embankment placed and 500 cubic yards of backfill placed or one test performed each day for either or as directed by the Engineer or recommended by Material Testing Consultant.

## 3.10 VIBRATION MONITORING

A. Vibration monitoring shall be performed at structures within 150 feet of the ongoing compaction work. A single monitoring point using vibration monitoring equipment capable of detecting velocities of 0.1 inch/second or less and survey measurements shall be used for vibration monitoring at each of the nearest structures. An elevation measurement on nearby structures shall be taken before compaction work starts, and then at least twice a day during the compaction work with one reading taken at the conclusion of the day's operations. Elevation measurements shall be recorded to an accuracy of 0.005 foot. If at any time the Contractor detects settlement or heave of 0.005 foot or more, or vibration levels of 1.0 inch/second or more, the vibratory compaction shall be stopped immediately, and the Engineer notified.

## 3.11 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS

A. The Contractor shall remove and dispose of off-site all excess and unsuitable materials. Within 30 consecutive days after Notice to Proceed, the Contractor shall submit to the Engineer for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.

B. All excess and unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state and local laws and regulations.

C. The Contractor shall obtain an off-site disposal area prior to beginning demolition or excavation operations.

D. All unsuitable materials shall be hauled off-site in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the propagation of dust.

E. Any surplus excavated material not used for backfilling or embankment that is suitable for reuse by Owner may be deposited on-site in a disposal area when and where directed by the Owner on a case-by-case basis. Approved disposal areas may also be used by the Contractor for spreading and drying any excavated material suitable as select fill that is too wet for use immediately after being excavated. The Contractor shall maintain the earth surfaces of the disposal area, both during the Work and until the completion of all seeding and mulching or other erosion control measures specified, in a manner which will effectively control erosion and sedimentation. If necessary, the Contractor shall clear and grub the disposal site prior to any excavation work.

    1. Earth waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practical, but in no case will slopes steeper than 3 horizontal to 1 vertical be permitted.

    2. The Engineer will have the authority to establish whatever additional requirements may be necessary to ensure the satisfactory appearance of the completed Work.

F. When all excess and unsuitable material disposal operations are completed, the Contractor shall leave the disposal sites in a condition acceptable to the Owner and Owner(s) of the disposal site(s).

## 3.12 BORROW EXCAVATION

A. Description

1. The work covered by this subsection consists of the excavation of approved material from borrow sources and the hauling and utilization of such material as required on the Drawings or directed by the Engineer. It shall also include the removing, stockpiling, and replacement of topsoil on the borrow source; the satisfactory disposition of material from the borrow source which is not suitable for use; and the satisfactory restoration of the borrow source and haul roads to an acceptable condition upon completion of the Work.

2. Borrow excavation shall not be used before all available suitable unclassified excavation has been used for backfilling and incorporated into the embankments.

B. Coordination with Seeding Operations

1. The Contractor shall coordinate the work covered by this Section with the construction of embankments and area fill so the requirements of Section 32 90 00 – Final Grading and Landscaping are met.

C. Borrow Materials

1. All material shall meet the requirements of PART 2 PRODUCTS for Select Fill or shall meet the requirements of Common Fill and classify as SM or coarser according to ASTM D2487.

D. Construction Methods

1. General

a. The surface of the borrow area shall be thoroughly cleared and grubbed and cleaned of all unsuitable material including all organics, topsoil, etc., before beginning the excavation. Disposal of material resulting from clearing and grubbing shall be in accordance with Section 31 10 00 – Clearing, Grubbing, and Site Preparation.

b. Each borrow operation shall not be allowed to accumulate exposed, erodible slope area in excess of 1 acre at any one given time without the Contractor's beginning permanent seeding and mulching of the borrow source or other erosion control measures as may be approved by the Engineer.

c. The topsoil shall be removed and stockpiled at locations that will not interfere with the borrow operations and that meet the approval of the Engineer. Temporary erosion control measures shall be installed as necessary to prevent the erosion of the stockpile material. Once all borrow material has been removed from the source or portion thereof, the stockpiled topsoil shall be spread uniformly over the source.

d. Where it is necessary to haul borrow material over existing roads, the Contractor shall use all necessary precautions to prevent damage to the existing roads. The Contractor shall also conduct hauling operations in such a manner as to not interfere with the normal flow of traffic and shall always keep the traffic lanes free from spillage.

2. Owner Furnished Sources

a. Where borrow sources are furnished by the Owner the location of such sources will be as designated on the Drawings or as directed by the Engineer.

b. The Owner will furnish the necessary haul road right-of-way at locations designated by the Engineer. All haul roads required shall be built, maintained, and when directed by the Engineer, obliterated, at no cost to the Owner. Where the haul road is to be reclaimed for cultivation the Contractor shall plow or scarify the area to a minimum depth of 8 inches, or to the depth requested by the property owner.

c. The borrow sources shall be left in a neat and presentable condition after use. All slopes shall be smoothed, rounded, and constructed not steeper than 3:1. Where the source is to be reclaimed for cultivation the source shall be plowed or scarified to a minimum depth of 8 inches, disc harrowed, and terraces constructed. The source shall be graded to drain such that no water will collect or stand, and a functioning drainage system shall be provided.

d. All sources shall be seeded and mulched in accordance with Section 32 90 00 – Final Grading and Landscaping.

3. Contractor Furnished Sources

a. Prior to the approval of any off-site borrow source(s) developed for use on this project, the Contractor shall obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the removal of the borrow material from the borrow source(s) will have no effect on any known district, site building, structure, or object that is included or eligible for inclusion in the National Register of Historic Places. A copy of this certification shall be furnished to the Engineer prior to performing any work on the proposed borrow source.

b. The approval of borrow sources furnished by the Contractor shall be subject to the following conditions:

1) The Contractor shall be responsible for acquiring the right to take the material and any rights of access that may be necessary; for locating and developing the source; and any clearing and grubbing and drainage ditches necessary.

a) Such right shall be in writing and shall include an agreement with the Owner that the borrow source may be dressed, shaped, seeded, mulched, and drained as required by these Specifications after all borrow has been removed.

2) The Contractor and the property owner shall jointly submit a borrow source development, use, and reclamation plan to the Engineer, as described in Article 1.05 SUBMITTALS, for approval prior to engaging in any land disturbing activity on the proposed source other than material sampling that may be necessary.

4. Maintenance

a. During construction and until final acceptance the Contractor shall use any methods approved by the Engineer which are necessary to maintain the work covered by this Section so that the work will not contribute to excessive soil erosion.

**END OF SECTION**

## SECTION 31 05 16
## AGGREGATE MATERIALS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment and materials required to complete all work associated with the installation of aggregate material beneath foundations, as backfill and as roadway subgrades and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 42 00 – References

B. Section 31 00 01 – Earthwork

C. Section 31 25 00 – Erosion and Sedimentation Control

D. Section 32 10 00 – Paving and Surfacing

E. Section 32 90 00 – Final Grading and Landscaping

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid:

1. Georgia Department of Transportation Standard Specifications Construction of Transportation Systems and Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems (GDOT Standard Specifications)

2. ASTM C127 – Test for Specific Gravity and Absorption of Coarse Aggregate.

3. ASTM C136 – Test for Sieve Analysis of Fine and Coarse Aggregates.

4. ASTM C535 – Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

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## 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Materials gradation and certification

2. ASTM C127, ASTM C136, and ASTM C535 test results

# PART 2 – PRODUCTS

## 2.01 CRUSHED STONE, SCREENED GRAVEL AND GRADED AGGREGATE BASE

A. Crushed stone or screened gravel shall meet the requirements of Aggregate Standard Size No. 57 or No. 67 as defined by GDOT Standard Specifications.

B. Graded aggregate base (GAB) shall meet the requirements of GAB as defined by GDOT Standard Specifications.

1. GAB may alternatively be referred to on the Drawings and elsewhere in the Specifications as CAB (crushed aggregate base) or ABC (aggregate base course), both of which shall mean GAB.

## 2.02 SELECT SAND

A. Select sand shall meet the requirements of Section 801 – Fine Aggregate of the GDOT Standard Specifications for materials and gradation. The size used shall be Size No. 10 NS or 10 FM.

# PART 3 – EXECUTION

## 3.01 CRUSHED STONE, SCREENED GRAVEL AND GRADED AGGREGATE BASE

A. Contractor shall install crushed stone, screened gravel and GAB in accordance with the GDOT Standard Specifications and as shown on the Drawings and indicated in the Contract Documents.

1. Unless otherwise stated herein or shown on the Drawings, all mat foundations (bottom slabs) for the proposed structures shall have a blanket of crushed stone or GAB 6 inches thick minimum placed directly beneath the proposed mat. The blanket shall extend a minimum of 12 inches beyond the extremities of the mat.

2. For subgrade preparation at structures and structural fill, the foundation material shall be GAB where specifically specified on Drawings, otherwise, crushed stone or screened gravel shall be used.

3. For ground under drains, pipe bedding, and drainage layers beneath structures the coarse aggregate shall meet the requirements of aggregate standard Size No. 57 or No. 67, as defined by GDOT Standard Specifications.

## 3.02 SELECT SAND

A. Contractor shall install select sand in accordance with the GDOT Standard Specifications and as shown on the Drawings and indicated in the Contract Documents.

**END OF SECTION**

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## SECTION 31 05 19
## GEOTEXTILES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all geotextiles, including all necessary and incidental items, as detailed or required for the Contractor to complete the installation in accordance with the Drawings and these Specifications.

B. Reference the Drawings for the location of each type of geotextile.

### 1.02 REFERENCES

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles

2. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

3. ASTM D5261 – Standard Test Method for Measuring Mass per Unit Area of Geotextiles

4. ASTM D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

5. AASHTO M 288 – Standard Specification for Geosynthetic Specification for Highway Applications

### 1.03 SUBMITTALS

A. Prior to shipping to the site, the Contractor shall submit to the Engineer two copies of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of geotextile. The Supplier shall also submit three geotextile samples of each product, 1 square yard each, seamed and unseamed as appropriate, with the mill certificate for each geotextile type supplied. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in the specifications. The samples shall be labeled with the manufacturer's lot number, machine direction, date of sampling, project number, specifications, manufacturer and product name.

B. The Engineer shall be furnished copies of the delivery tickets or other acceptable receipts as evidence for materials received that will be incorporated into construction.

## PART 2 – MATERIALS

### 2.01 MATERIALS

A. Filter Geotextile shall be a minimum 6-ounce per square yard (nominal) nonwoven needle punched synthetic fabric consisting of staple or continuous filament polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a pH range from 3 to 10. The geotextiles shall have a minimum threshold water head of 0.25 inch in the "as received" condition.

1. Filter Geotextile shall have a Survivability Class of Class 1 or 2 in accordance with AASHTO M288, unless otherwise specified herein.

B. Cushion Geotextile shall be a minimum 16-ounce per square yard nonwoven needle punched synthetic fabric consisting of continuous filament or staple polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a pH range from 3 to 10.

1. Cushion Geotextile shall have a Survivability Class of Class 1 in accordance with AASHTO M288.

C. Type I Separator Geotextile shall be a minimum 8-ounce per square yard (nominal) nonwoven needle punched synthetic fabric consisting of staple or continuous filament polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The geotextiles shall be inert and unaffected by long term exposure to chemicals or liquids with a pH range from 3 to 10.

1. Type I Separator Geotextile shall have a Survivability Class of Class 1 or 2 in accordance with AASHTO M288, unless otherwise specified herein.

D. Type II Separator Geotextile shall be a woven slit film or monofilament synthetic fabric consisting of polyester or polypropylene in a manner approved by the Engineer. Geotextile shall be treated to resist degradation due to exposure to ultraviolet light.

1. Type II Separator Geotextile shall have a Survivability Class of Class 1 in accordance with AASHTO M288, unless otherwise specified herein.

E. All geotextiles shall conform to the properties listed using the test methods listed in Table 1 in this Section. The Contractor shall be responsible for timely submittals of all confirmation test data for geotextiles.

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## PART 3 – EXECUTION

### 3.01 SHIPPING, HANDLING AND STORAGE

A. During all periods of shipment and storage, all geotextiles shall be protected from direct sunlight, temperatures greater than 140°F, water, mud, dirt, dust, and debris.

B. To the extent possible, the geotextile shall be maintained wrapped in heavy-duty protective covering until use. Geotextile delivered to the Project Site without protective covering shall be rejected. After the protective covering has been removed, the Geotextile shall not be left uncovered for longer than 14 days under any circumstances.

C. The Owner will approve the shipping and delivery schedule prior to shipment. The Owner will designate the on-site storage area for the geotextiles. Unloading and storage of geotextiles shall be the responsibility of the Contractor.

D. Geotextiles that are damaged during shipping or storage shall be rejected and replaced at Contractor expense.

### 3.02 QUALITY ASSURANCE CONFORMANCE TESTING

A. At the option of the Engineer, representative samples of geotextiles shall be obtained and tested by the Engineer to assure that the material properties conform to these Specifications. Conformance testing shall be conducted by the Engineer and will be paid for by the Owner.

B. Conformance testing shall be completed at a minimum frequency of one sample per 100,000 square feet of geotextile delivered to the Project Site. Sampling and testing shall be as directed by the Engineer.

C. Conformance testing of the geotextiles shall include but not be limited to the following properties:

1. Mass per Unit Area (ASTM D5261)

2. Grab Tensile Strength (ASTM D4632)

3. Trapezoidal Tear (ASTM D4533)

4. Puncture Resistance (ASTM D6241)

D. The Engineer may add to, remove or revise the test methods used for determination of conformance properties to allow for use of improved methods.

E. All geotextile conformance test data shall meet or exceed requirements outlined in Table 1 of this Section for the particular category of geotextile prior to installation. Any materials that do not conform to these requirements shall be retested or rejected at the direction of the Engineer.

F. Each roll of geotextile will be visually inspected by the Engineer or the Engineer's representative. The Engineer reserves the right to sample and test at any time and reject, if necessary, any material based on visual inspection or verification tests.

G. A geotextile that is rejected shall be removed from the Project Site and replaced at the Contractor's expense. Sampling and conformance testing of the geotextile supplied as replacement for rejected material shall be performed by the Engineer at Contractor's expense.

## 3.03 INSTALLATION

A. Geotextiles shall be placed to the lines and grades shown on the Drawings. At the time of installation, the geotextile shall be rejected by the Engineer if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.

B. It is the intent of this Section that geotextiles used to protect natural drainage media be placed the same day as the drainage media to prevent soil, sediment or windblown soils to make contact with the drainage media.

C. The geotextiles shall be placed smooth and free of excessive wrinkles. Geotextiles shall conform to and be in contact with the approved subgrade.

D. When the geotextiles are placed on slopes, the upslope fabric portion shall be lapped such that it is the upper or exposed geotextile.

E. Geotextiles shall be temporarily secured in a manner accepted by the Engineer prior to placement of overlying materials.

F. In the absence of specific requirements shown on the Drawings, the following shall be used for overlaps of adjacent rolls of geotextile:

| Geotextile Type/Application | Minimum Overlap of Adjacent Rolls[1] (Inches) | Minimum Transverse End Overlap (Inches) |
|---|---|---|
| Filter Geotextile | 6 | 12 |
| Cushion Geotextile | 12 | 12 |
| Separator - Roadway Applications | 12 | 24 |
| Separator - Slope Protection | 18 | 24 |
| Separator Geotextile | 12 | 18 |

(1) Overlaps may be reduced if adjacent panels are sewn or heat bonded where approved by the Engineer.

G. Any geotextile that is torn or punctured shall be repaired or replaced as directed by the Engineer by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of geotextile placed over the failed areas and shall overlap the existing geotextile a minimum of 12 inches from any point of the rupture.

H. Any geotextile that is subjected to excessive sediment buildup on its surface during construction shall be replaced by the Contractor prior to placement of overlying material.

**Table 1: Minimum Required Geotextile Properties***

| Geotextile Property | Filter Geotextile | Cushion Geotextile | Type I Separator Geotextile | Type II Separator Geotextile |
|---|---|---|---|---|
| Geotextile Construction | Nonwoven Needle punched | Nonwoven Needle punched | Nonwoven Needle punched | Woven |
| Ultraviolet Resistance, (500 hrs) ASTM D7238, Average % Strength Retention | 70 | 70 | 70 | 70 |
| Grab Tensile Strength (lbs), ASTM D4632 | 120 | 340 | 160 | 315 |
| Grab Tensile elongation (%) ASTM D4632 | 50 | 50 | 50 | 15 |
| Trapezoid Tear Strength (lbs) ASTM D4533 | 50 | 155 | 60 | 120 |
| Apparent Opening Size (AOS), (mm), ASTM D4751 | 0.212 | N/A | 0.212 | 0.425 |
| Permittivity at 50 mm constant head ($sec^{-1}$), ASTM D4491 | 0.5 | N/A | 1.5 | 0.1 |
| CBR Puncture Strength, ASTM D6241 (lbs) | 340 | 1,100 | 410 | 900 |

* MINIMUM AVERAGE ROLL VALUE (MARV)

**END OF SECTION**

## SECTION 31 10 00
## CLEARING, GRUBBING, AND SITE PREPARATION

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Includes all labor, material, equipment and appliances required for the complete execution of any additions, modifications, or alterations to existing building(s) and new construction work as shown on the Drawings and specified herein.

B. Principal items of clearing, grubbing, and site preparation work include:

1. Notifying all authorities owning utility lines running to or on the property. Protecting and maintaining all utility lines to remain and capping those that are not required in accordance with instructions of the Utility Companies, and all other authorities having jurisdiction.

2. Clearing the site within the Contract Limit Lines, including removal of grass, brush, shrubs, trees, loose debris and other encumbrances except for trees marked to remain.

3. Boxing and protecting all trees, shrubs, lawns and the like within areas to be preserved. Relocating trees and shrubs, so indicated on the Drawings, to designated areas.

4. Repairing all injury to trees, shrubs, and other plants caused by site preparation operations shall be repaired immediately. Work shall be done by qualified personnel in accordance with standard horticultural practice and as approved by the Engineer.

5. Removing topsoil to its full depth from designated areas and stockpiling on site where directed by the Engineer for future use.

6. Disposing from the site all debris resulting from work under this Section.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

B. Section 31 25 00 – Erosion and Sedimentation Control

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## 1.03 STREET AND ROAD BLOCKAGE

A. Closing of streets and roads during progress of the clearing, grubbing and site preparation work shall be in compliance with the requirements of the Owner and other authorities having jurisdiction. Access shall be provided to all facilities remaining in operation.

## 1.04 PROTECTION OF PERSONS AND PROPERTY

A. All clearing, grubbing and site preparation work shall be performed in such a manner to protect all personnel, workmen, pedestrians and adjacent property and structures from possible injury and damage.

B. All conduits, wires, cables and appurtenances above or below ground shall be protected from damage.

C. Provide warning and barrier fence where shown on the Drawings and as specified herein.

# PART 2 – EXECUTION

## 2.01 CLEARING OF SITE

A. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shall be cleared and grubbed.

B. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, sanitary landfill material, fencing, and other perishable and objectionable material within the areas to be excavated or other designated areas. Prior to the start of construction, the Contractor shall survey the entire Contract site and shall prepare a plan which defines the areas to be cleared and grubbed, trees to be pruned, extent of tree pruning, and/or areas which are to be cleared but not grubbed. This plan shall be submitted to the Engineer for approval. Should it become necessary to remove a tree, bush, brush or other plants adjacent to the area to be excavated, the Contractor shall do so only after permission has been granted by the Engineer.

C. Excavation resulting from the removal of trees, roots and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 31 00 01 – Earthwork.

D. Unless otherwise shown or specified, the Contractor shall clear and grub a strip at least 15 feet wide along all permanent fence lines installed under this Contract.

E. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this

Contract, and removal shall be subject to approval by the Engineer. However, the Engineer reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such, in their opinion, are too close to the Work to be maintained or have become damaged due to the Contractor's operations.

## 2.02 STRIPPING AND STOCKPILING EXISTING TOPSOIL

A. Erosion and sedimentation control measures shall be installed as per the Federal, State or Locally approved Erosion and Sedimentation Control Plan for the project and Specification Section 31 25 00 – Erosion and Sedimentation Control before any stripping and stockpiling of topsoil can occur.

B. Existing topsoil and sod on the site within areas designated on the Drawings shall be stripped to whatever depth it may occur and stored in locations directed by the Engineer.

C. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling the topsoil.

D. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

## 2.03 GRUBBING

A. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks and other perishable materials to a depth of at least 6-inches below ground surfaces.

B. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

## 2.04 DISPOSAL OF MATERIAL

A. All debris resulting from the clearing and grubbing work shall be disposed of by the Contractor as part of the Work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed by the Engineer for reuse in this Project or removal by others.

B. Burning of any debris resulting from the clearing and grubbing work will not be permitted at the site.

## 2.05 WARNING AND BARRIER FENCE

A. The fence shall be made of a visible, lightweight, flexible, high strength polyethylene material. The fence shall be Guardian Visual Barrier by Tenax, or equal.

B. Physical Properties

| **Fence** | |
|---|---|
| Color | International Orange |
| Height (feet) | 4 |
| Roll Weight (oz/CY) | 3 |
| Mesh Opening (inches) | 1-3/4 x 1-3/4 |
| **Posts** | |
| ASTM Designation | A702 |
| Length (feet) | 6 (T-Type) |
| Minimum Weight (pounds/foot) | 1.25 |
| Area of Anchor Plate (square inches) | 14 |

C. Drive posts 18 inches into ground every 8 feet. Wrap fence material around first terminal post allowing overlap of one material opening. Use metal tie wire or plastic tie wrap to fasten material to itself at top, middle and bottom. At final post, cut with utility knife or scissors at a point halfway across an opening. Wrap around and tie at final post in the same way as the first post.

D. Use tie wire or tie wrap at intermediate posts and splices as well. Thread ties around a vertical member of the fence material and the post and bind tightly against the post. For the most secure fastening, tie at top, middle and bottom. Overlap splices a minimum of four fence openings, tie as above, fastening both edges of the fence material splice overlap.

**END OF SECTION**

# SECTION 31 23 24
# FLOWABLE FILL

## PART 1 – GENERAL

### 1.01 WORK INCLUDED

A. The Contractor shall furnish all labor, equipment, materials and services, including pumping equipment and application, necessary for the manufacture, transportation and placement of all cementitious flowable fill as shown on the Drawings or as ordered by the Engineer, except for the work specifically included under other items.

### 1.02 RELATED WORK

A. Division 03 – Concrete

### 1.03 SUBMISSIONS

A. In accordance with the procedures and requirements set forth in the General Conditions, as modified by the Supplementary Conditions, and Division 01 – General Requirements, the Contractor shall submit the following:

1. Shop drawings
2. Certifications of specification compliance for all sources of each material
3. Manufacturer's data on all admixtures
4. Mix design and trial mix test results
5. Aggregate gradation

### 1.04 QUALITY CONTROL

A. The Contractor shall engage the services of a testing laboratory, with the qualifications required by Section 03 30 00 – Cast-in-Place Concrete, and experienced in the design and testing of flowable fill materials and mixes, to perform material evaluation tests and to design mixes for flowable fill. A trial mix shall be performed to verify the flowable fill mix design. The trial mix shall also report slump, air content, yield, cement content, and dry unit weight per ASTM C143 and ASTM D6023.

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## PART 2 – MATERIALS

### 2.01 CEMENTITIOUS FLOWABLE FILL

A. Flowable fill (controlled low strength material) shall be a uniform mixture of sand, Type II Portland cement or Type IL blended cement, fly ash, admixtures and water. The mix design shall produce a flowable material with little or no bleed water, which produces a minimum compressive strength of 50 psi and maximum compressive strength of 100 psi at 56 days. The cured material shall be excavatable and have a maximum dry weight of 100 pounds per cubic foot. Slump of mix at the point of application shall be 7 to 10 inches.

B. Admixtures specifically designed for flowable fill shall be used to improve flowability, reduce unit weight, control strength development, reduce settlement and reduce bleed water. Admixtures shall be Mastercell 25 by BASF Construction Chemicals; Darafill by Grace Construction Products; or approved equal. Cement and all other materials shall be as specified in Section 03 30 00 – Cast-in-Place Concrete.

C. Fine Aggregate (Sand) shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the following limits:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 3/8" | 100 |
| No. 4 | 95 to 100 |
| No. 8 | 80 to 100 |
| No. 16 | 50 to 85 |
| No. 30 | 25 to 60 |
| No. 50 | 10 to 30 |
| No. 100* | 2 to 10 |

*For manufactured sand, the percent passing the No. 100 Sieve may be increased up to 20%.

## PART 3 – EXECUTION

### 3.01 PLACEMENT OF FLOWABLE FILL

A. Flowable fill shall be batched and premixed by an approved producer, dispensed from ready-mix trucks, and placed by approved methods and equipment.

B. Flowable fill shall be placed as needed to completely fill the space to receive it with no trapped air pockets or other voids. Positive means of allowing the air to escape shall be provided where necessary and after approval of the Engineer. Where placed against, around and inside existing structures, lift heights shall be limited so as not to overload the structure. The Engineer will approve lift heights and procedures. Specific procedures and methods shall be included in the Contractor's shop drawing submittals.

C. Where flowable fill is placed around piping and other elements subject to floating within the fill space, positive means shall be taken to provide temporary balancing loads to prevent uplift or fill lift heights shall be limited to prevent uplift.

D. Application of loads or placement of other fill materials or concrete on top of flowable fill shall not occur until the flowable fill surface is determined to be suitable for loading per ASTM D6024 subject to the approval of the Engineer.

**END OF SECTION**

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## SECTION 31 25 00

## EROSION AND SEDIMENTATION CONTROL

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall be responsible for implementing best management practices (BMPs) to prevent and minimize soil erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This item covers all work necessary for the installation of structures and measures to control soil erosion resulting from construction operations, prevent the flow of sediment from the Project Site, and contain construction materials (including excavation and backfill) within the protected working area to prevent damage to any stream or wetlands. The Contractor shall furnish all material, labor, and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and sediment control measures and, if applicable, to cause compliance with all local permits and the NPDES Permit as defined herein under this Section.

B. Any land disturbance as the result of modifications to a site's drainage features or topography requires protection from erosion and sedimentation.

C. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

D. It is the intent of this Section that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

E. All work under this Contract shall be done in conformance with and subject to the limitations of the Manual for Erosion and Sediment Control in Georgia (the "Green Book"), 2016 Edition or latest update, as adopted by the Georgia Soil and Water Conservation Commission (GSWCC).

F. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the erosion and sediment control devices will be adjusted on several occasions to reflect the current phase of the Work. The Progress Schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation

control provisions shown on the Drawings shall have the prior acceptance of the Engineer and shall be completed at no additional cost to the Owner.

G. Erosion and sedimentation controls applicable to this Project shall be as shown on the Drawings, as specified herein, as indicated by the Engineer, and as detailed in the GSWCC “Green Book”.

## 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 31 00 01 – Earthwork

C. Section 31 05 16 – Aggregate Materials

D. Section 31 05 19 – Geotextiles

E. Section 32 90 00 – Final Grading and Landscaping

## 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section:

1. General NPDES Permit No. GAR100001 – Authorization To Discharge Under The National Pollutant Discharge Elimination System – Stormwater Discharges Associated With Construction Activity For Stand Alone Construction Projects (the NPDES Permit)

2. GSWCC “Green Book”, 2016 Edition or latest update

3. Georgia Department of Transportation Standard Specifications Construction of Transportation Systems and Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems (GDOT Standard Specifications)

4. National Stone Association, Aggregate Classification (the NSA Classification)

5. Cherokee County Erosion and Sedimentation Control Ordinance

6. Erosion, Sedimentation, and Pollution Control Plan (the Plan) as required by the NPDES Permit

## 1.04 QUALITY ASSURANCE

A. Contractor's operations shall be restricted to the areas of work shown on the Drawings and the area which must be entered for construction of temporary or permanent facilities.

B. Engineer and Owner reserve the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, and borrow and fill operations and to direct the Contractor to install immediate permanent or temporary erosion, sediment, and pollution control measures to prevent contamination of any stream or wetlands, including the construction of temporary berms, dikes, dams, sediment basins, sediment traps, and slope drains and the use of temporary mulches, mattings, or other devices or methods to control erosion.

## 1.05 DEFINITIONS

A. Engineer: For the purpose of this Section, the term Engineer is synonymous with consulting engineer, licensed professional, designer, and consultant used in permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references. For the purposes of this item, the Engineer may at any time during the Project provide direction. This direction shall be considered equivalent to direction from the Owner.

B. Contractor: For the purposes of this Section, the term Contractor is synonymous with General Contractor, Discharger, Operator, Primary Permittee, and Permittee (permit holder) as used in permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references.

C. Qualified Personnel: For the purposes of this Section, the terms Qualified Personnel or Qualified Person mean a person who has successfully completed an erosion and sediment controls short course eligible for continuing education units or an equivalent course approved by the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources (DNR) and the GSWCC.

D. Other Definitions: Definitions as listed in the NPDES Permit, Part I.B. shall apply in this Section.

## 1.06 REGULATORY COMPLIANCE

A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the state of Georgia, and Cherokee County as necessary. The Contractor is the Co-Primary Permittee and Operator under the provisions of the NPDES Permit. As such, the Contractor shall be required to sign certain certifications as described in the NPDES Permit and submit a Notice of Intent (NOI) and Notice of Termination (NOT) as indicated herein in Article 1.07 and Article 3.04, respectively. Contractor shall comply with requirements specified in the Contract Documents, on the Plan, and by the Engineer. Contractor shall also comply

with all other laws, rules, regulations, ordinances, and requirements concerning soil erosion and sediment control established in the United States, the state of Georgia, and Cherokee County as applicable. The following documents and the documents referenced therein define the regulatory requirements for this Section:

1. The NPDES Permit: The NPDES Permit governs land disturbance or construction activities of 1 acre or more. On applicable sites, Contractor shall be responsible for complying with terms and conditions of this permit.

2. GSWCC "Green Book": Contractor shall follow Practices and Standards of the latest edition of the GSWCC "Green Book".

B. During the period beginning on the effective date of the Notice to Proceed and lasting until the Project is accepted by the Owner, the Contractor shall control, limit, and monitor all discharged stormwater associated with construction activity including clearing, grading, and excavation activities resulting in the disturbance of land and related support activities as specified and as follows:

1. Manage onsite activities such that no adverse impacts to water quality occur from site activities or allowed discharges. The following activities, and others on a site-specific basis, require oversight throughout the construction and development process to assure that all water quality standards are protected.

a. Equipment Operation and Maintenance: Equipment utilized during construction must be operated and maintained in such a manner to prevent the potential or actual pollution of the surface or ground waters of the state. Chemicals, fuels, lubricants, bitumen, coolants, hydraulic fluids, or any other petroleum products or harmful waste shall not be discharged onto the ground, into or alongside any surface waters, or into natural or manmade channels. Spent fluids shall be disposed of in a manner to not enter the groundwater or surface waters of the state and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner to not allow their entry into the ground water or surface waters of the state.

b. Material Handling: Herbicide, pesticide, and fertilizer usage during the construction activity shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act and in accordance with label restrictions.

c. Building Material Waste Handling: All wastes composed of building materials shall be disposed of in accordance with applicable state and federal rules governing the disposal of solid waste. In particular, the following guidelines shall be followed:

i. No paint or liquid wastes shall be disposed of in streams or storm drains.

ii. Dedicated area for demolition, construction, and other wastes must be located a minimum of 50 feet from storm drains and streams unless no reasonable alternatives are available.

iii. Earthen-material stockpiles must be located a minimum of 50 feet from storm drains and streams unless no reasonable alternatives are available.

iv. Onsite concrete materials, including excess concrete, must be controlled to avoid contact with surface waters, wetlands, and buffers.

d. Litter and Sanitary Waste: The Permittee shall control the management and disposal of litter and sanitary waste from the site.

C. Violations and Fines

1. Contractor shall be responsible for reimbursing the Owner for any fines incurred as a result of violations to the Georgia Erosion and Sedimentation Act, the NPDES Permit, and any applicable delegated local program's sediment control regulations until construction activities are complete and the project is accepted by the Owner. These include fines levied by the Georgia EPD Land Protection Branch, Georgia EPD Watershed Protection Branch, and delegated local programs.

2. If violations result in the issuance of a Notice of Violation, the Contractor shall comply with the requirements of the Notice within the specified time period for compliance. Failure to comply could result in the assessment of a penalty for each day of the continuing violation, beginning on the date of the violation.

3. Violations may result in civil and/or criminal penalties including fines and imprisonment.

## 1.07 SUBMITTALS

A. Prior to the start of the work, the Contractor shall prepare and submit a plan for implementing the temporary and permanent erosion and sedimentation control measures as shown on the Plan approved by the appropriate regulatory authority. The Work shall not commence until the schedule of work and the methods of operations have been reviewed and approved.

B. The Contractor shall submit a Notice of Intent (NOI) for the NPDES Permit to Georgia EPD prior to breaking ground. NOI shall be electronically completed and submitted through the Georgia EPD Online System (GEOS) in accordance with the requirements of the NPDES Permit. Submittal shall be coordinated with Owner and Engineer. Contractor shall be responsible for paying all fees associated with the NPDES Permit.

C. Contractor shall submit a proposed schedule for installation, maintenance, and removal of all temporary and permanent erosion and sediment control measures to the Engineer. The schedule shall reflect the requirements of Article 1.09 and shall state the anticipated starting and completion dates for all applicable land development activities including, but not limited to:

1. Installation of temporary and permanent sediment control structures
2. Stormwater management facilities
3. Timber salvage operations
4. Clearing operations
5. Grubbing operations
6. Rough and finished grading
7. Building construction
8. Landscaping, including all seeding
9. Removal of temporary sediment control structures

D. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Product Data
2. Hydroseed mix and application rates for seed, lime, fertilizer, and wood cellulose fiber mulch
3. Certification of all materials
4. Composition and germination certification of test results for grass seed
5. Plans and specifications for two vehicle cleaning (truck wash down) stations.

E. In accordance with the procedures and requirements set forth in the General Conditions, Supplementary Conditions, and Division 01 – General Requirements including, but not limited to, Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Name and location of all material suppliers
2. Certificate of compliance with the standards specified herein for each source of each material

3. List of offsite borrow sources and disposal sites for waste and unsuitable materials and evidence of all required federal, state, and local permits for use of those sites

## 1.08 GUARANTEE

A. All restoration and revegetation work shall be subject to the 1-year guarantee period of the Contract as specified in the General Conditions.

## 1.09 SEQUENCE OF CONSTRUCTION OF TEMPORARY SEDIMENT CONTROL MEASURES

A. Install all erosion and sediment control structures specified herein and shown on the Drawings, or as directed by the Engineer, as the first item of work within a given drainage area. Construction and installation of all sediment control structures shall begin downgrade of the area to be disturbed and shall proceed upgrade. Contractor shall maintain all soil erosion and sediment control structures and practices at all times throughout construction and until permanent grass cover is established.

B. Time: Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the state of Georgia, and Cherokee County.

## 1.10 BUFFER ZONES

A. Construction within a buffer zone of a Water of the United States must meet the following requirements.

B. Definition: The buffer zone is officially defined as the distance (in feet) from the edge of the normal high water line (or for wetlands, the distance from the boundary of the wetland). The buffer zone for small streams (as determined by the Engineer) shall start at the top of the bank, and the buffer zone for larger streams (as determined by the Engineer) and rivers shall start at the edge of the vegetation. Buffer zones are specified in the following table:

| Type of Stream Buffer Associated with Little River | Distance |
|---|---|
| Little River | 150 feet |
| Impervious Surface Setback | 75 feet |
| Undisturbed Cherokee County | 50 feet |
| Undisturbed State Water | 25 feet |

C. Construction Activity: Construction activity within the buffer zone must be approved by the Engineer. Any encroachments must immediately be mulched and/or seeded in

accordance with the requirements of Article 2.11 (the General Criteria of Article 2.11 are superseded by the requirements of Article 1.10). All construction within a buffer zone must be complete as soon as possible and within 24 hours of initial land disturbance within the buffer when possible.

## PART 2 – PRODUCTS

### 2.01 SPECIFIC REQUIREMENTS

A. The requirements specified herein and shown on the Drawings are minimum requirements for the preventing or minimizing soil erosion and sediment transport. Contractor shall install and maintain soil erosion and sediment control measures in accordance with the following criteria. Requirements set forth in the latest edition of the GSWCC “Green Book” shall govern in case of conflicting information, unless clearly identified as a deviation from the GSWCC “Green Book”.

### 2.02 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DIKES

A. Install interceptor, diversion, and perimeter dikes to intercept and prevent stormwater runoff from entering disturbed areas from any other upgrade area regardless of whether area is on-site or off-site. Dikes must divert runoff to a drainage ditch, sediment basin, or temporary or permanent channel. Dikes shall remain in place until the disturbed area is permanently stabilized. Construct dikes of earth fill free from all perishable matter and refuse, such as scrap forms, wire, brush, rocks larger than 6 inches, or any foreign materials. Ashes, large stones, muck, or other soft materials shall not be used. Compact all dikes using construction equipment. Dikes shall be stabilized immediately after construction with temporary seeding to prevent sediment transport to downstream areas.

### 2.03 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DITCHES

A. Install temporary ditches where shown on the Drawings or as directed by the Engineer. In general, temporary ditches shall be installed parallel and contiguous to and upgrade of temporary dikes. Construct ditches to the lines and cross section shown on the drawings, provided that ditches have a minimum depth of 1 foot and side slopes have a slope of 2H:1V or flatter. Ditches shall be free of bank projections, trees, brush, stumps, or other objectionable materials or irregularities that will impede normal flows. Downstream outlets of temporary ditches shall be constructed and stabilized prior to construction of the ditch. The outlet must discharge in such a manner as to not cause an erosion problem.

### 2.04 TEMPORARY SEDIMENT BARRIERS (SILT FENCE)

A. Install silt fence where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Filter fabric, woven wire support fence or polypropylene support mesh, posts, and fasteners must meet the requirements set forth in Section 171 – Silt

Fence, Section 881 – Fabrics, and Section 894 – Fencing of the GDOT Standard Specifications. Contractor shall submit to Engineer copies of delivery invoices, certifications, or other documentation that the filter fabric, woven wire support fence or polypropylene support mesh, posts, and fasteners comply with these specifications if requested by the Engineer.

C. Installation: In general, silt fencing shall be installed on the downgrade side of all areas to be disturbed as well as the perimeter of the Project site (Engineer may authorize an exception for a perimeter which is upgrade from all land disturbing activity). Installation of silt fence shall comply with the specifications in the latest edition of the GSWCC "Green Book". Posts must be placed at least 18 inches in the ground and cannot be more than 6 feet apart from one another. Fence fabric must be inserted below ground and fence fabric must be fastened to posts according to the specifications in the Manual. Contractor shall install either non-sensitive (Type A and Type B) or sensitive (Type C and Type C-System) silt fence, as shown on the Drawings or when directed by the Engineer.

D. Maintenance: In accordance with Article 3.01, all silt fencing shall be inspected and maintenance performed, if needed, within 24 hours of inspection and once every 7 calendar days and within 24 hours of a rainfall event that had precipitation of 1/2 inch or greater. All silt fencing materials, including fabric, post, and fasteners must be replaced 6 months after installation. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of 1/3 the installed fence height, all soil, silt, sediment, and other material captured by the silt fence shall be removed and returned upgrade on the Project Site to a location which will minimize the chance for further sediment transport. Temporary or permanent ground cover shall be established as necessary to reduce erosion. The silt fence shall be maintained such that it minimizes sediment transport as designed.

## 2.05 TEMPORARY SEDIMENT BARRIERS (HAY BALES)

A. Install bales of hay where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Hay bales shall be wire or nylon bound and of rectangular shape.

C. Installation: Place bales in a row with ends tightly abutting the adjacent bales. Corner abutment is not acceptable. Embed bales in the soil a minimum of 4 inches below grade. Build up backfilled soil a minimum of 4 inches above grade on the uphill side of the barrier and conform to grade on the downhill side of the barrier. Anchor each bale in place with 1-inch by 2-inch wood stakes or No. 3 reinforcing bars. The first stakes shall be driven toward the previously laid bale to force the bales together. Stakes shall be 24 inches long and shall reach a minimum of 6 inches into the ground.

D. Maintenance: In accordance with Article 3.01, all hay bales shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar

days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Hay bales must be replaced 1 month after installation. At the earlier of (1) every 14 calendar days or (2) when sediment and other material captured by the hay bales reaches 1/3 the height of the original bales such sediment shall be removed and returned upgrade on the Project Site. The hay bales shall be maintained such that they minimize sediment transport as designed.

## 2.06 ROCK FILTER DAMS

A. Install rock filter dams where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Filter fabric must meet the requirements set forth in Section 171 – Silt Fence, of the GDOT Standard Specifications. Stone shall be No. 57 stone as defined by GDOT Standard Specifications. Hardware cloth between filter fabric and No. 57 stone shall be 1/2-inch mesh. Contractor shall submit to Engineer copies of delivery invoices, certifications, or other documentation that the filter fabric, stone, and hardware cloth complies with these specifications if requested by the Engineer.

C. Installation: In general, rock filter dams shall be installed at the low point of all silt fence as the perimeter of the Project site (Engineer may authorize an exception for a perimeter which is upgrade from all land disturbing activity). Minimum length of rock filter dam shall be 10 feet.

D. Maintenance: In accordance with Article 3.01, all rock filter dams shall be inspected and maintenance performed, if needed, within 24 hours of inspection and once every 7 calendar days and within 24 hours of a rainfall event that had precipitation of 1/2 inch or greater. All materials, including filter fabric, stone and cloth hardware, and fasteners must be replaced 6 months after installation. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of 1/3 the installed height, all soil, silt, sediment, and other materials captured by the rock filter dam shall be removed and returned upgrade on the Project Site. The rock filter dam shall be maintained such that it minimizes sediment transport as designed.

## 2.07 CONSTRUCTION EXITS

A. Locate construction exits as shown on the Drawings or as directed by the Engineer.

B. Material Specifications: A geotextile underliner, conforming to Section 881.2.05 – Plastic Filter Fabric, GDOT Standard Specifications, shall be used in all instances to stabilize and support the pad aggregate. Aggregate size shall conform to the National Stone Association's (NSA) R-2 classification 1.5-inch to 3.5-inch stone.

C. Installation: Construction exits shall be located at all points where traffic will be leaving the Project Site to a public or private right of way, street, alley, or parking area. All construction exits must be fully installed prior to the commencement of timber salvage, clearing, grubbing, grading, or construction operations.

D. Maintenance: In accordance with Article 3.01, all construction exits shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. At the earlier of (1) 30 calendar days since construction exit was installed or last maintained, or (2) geotextile underliner is visible or if construction exit does not conform to specifications established in this Section, construction exit pad shall be top dressed with NSA's R-2 (1.5-inch to 3.5-inch stone) such that underliner is no longer visible and exit pad conforms to specifications.

## 2.08 CHECK DAMS

A. Install check dams as shown on the Drawings or as directed by the Engineer.

B. Installation: Install check dams in all ditches, channels, or swales draining disturbed areas of 1 acre or greater and which are not installed with permanent, non-erodible lining or a vegetative cover as specified in Article 2.11. The requirements for the design criteria, materials, installation, and maintenance of check dams are dependent on the upslope drainage area and are described as follows. A check dam shall not drain a disturbed area greater than 10 acres.

1. Check Dam for Ditches Draining up to 2 Acres: Hay bales may be used if installation conforms to the requirements in Article 2.05.

2. Check Dam for Ditches Draining Up to 5 Acres: Install stone check dams in ditches draining upgrade areas greater than 2 acres but less than 5 acres. Construct check dam with graded size 5- to 10-inch stone. Hand placement may be required to ensure complete coverage of the entire width of ditch.

3. Check Dam for Ditches Draining Up to 5 to 10 Acres: Check dams for use with drainage areas between 5 and 10 acres must serve as a sediment filtering device in addition to reducing the velocity of stormwater runoff. Construct check dam with graded size 5- to 10-inch stone. Check dam shall not substantially impound water. Hand placement may be required to ensure complete width and depth of ditch.

C. Maintenance: In accordance with Article 3.01, all check dams shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Dress dams with appropriate sized stone or additional hay bales as necessary to maintain check dams in accordance with these specifications. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of 1/3 the original check dam height, all soil, silt, sediment, and other material captured by the dam shall be removed and returned upgrade on the Project Site.

## 2.09 INLET SEDIMENT TRAPS

A. Install inlet sediment traps where shown on the Drawings, as directed by the Engineer, and all around storm drain drop inlets that receive runoff from disturbed areas. Inlet sediment traps shall be excavated inlet sediment traps, filter fabric with supporting frames, baffle boxes, block and gravel drop inlet protection, gravel drop inlet protection, sod inlet protection, and/or curb inlet protection as appropriate for the application and as described in the GSWCC “Green Book”

B. Material Specifications: Filter fabric used on constructing inlet sediment traps shall conform to the specifications established in Article 2.06. For gravel drop inlet filters, stone shall conform to NSA’s R-3 specification (3- to 6-inch stone). Baffle box inlet filters shall be constructed of 2-inch x 4-inch posts and 2-inch x 4-inch boards.

C. Installation: Install in accordance with the GSWCC “Green Book”. Excavation may only be used in combination with a filtering device such as stone or silt fence. All sediment traps shall provide a minimum of 1.5 feet of sediment storage. Sediment traps must be self-draining.

D. Maintenance: In accordance with Article 3.01, all inlet sediment traps shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Clean and repair traps such that traps meet the specifications of this Section and minimize sediment transport. Remove sediment as necessary to provide adequate storage volume for subsequent rains.

## 2.10 TEMPORARY SEDIMENT BASINS AND INLETS

A. Install temporary sediment basins and inlets where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Concrete used in constructing sediment basins shall be ready mixed, conforming to ASTM C94, Alternate 2. Compressive filed strength shall be not less than 2,500 psi at 28 days. Maximum size of aggregate shall be 1.5 inches. Slump shall be between 2 and 4 inches. Field strength shall be assumed as equal to 85 percent of the strength of laboratory-cured cylinders. Forms used in constructing sediment basin shall have exposed surfaces of plywood; others shall be steel, matched boards, plywood, or other acceptable material. Form all vertical surfaces. Provide fillets on reentrant angles. Trench walls, large rock, or earth are not acceptable form material. Reinforcing steel shall conform to ASTM A615, Grade 40, deformed bars. At the option of the Contractor, approved precast units may be substituted for cast-in-place units. Precast units shall conform to ASTM C478. Submit details of proposed units to the Engineer for review. Concrete risers for extension shall be a maximum of 6 inches high and of the same quality as the sections. Risers shall be reviewed by Engineer before installation. Mortar shall be standard premised mortar conforming to ASTM C387, Type S, or proportion 1 part Portland cement to 2 parts clean, well-graded sand which will

pass a 1/8-inch screen. Admixtures may be sued not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the concrete. Cast iron frames and gratings for catch basins and storm drain inlets shall be designed for AASHTO H-20 truck loading and shall be bike-proof reticuline grates. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts and all defects, and shall conform to ASTM A48, Class 30.

C. Construction: Excavation of basin and backfill of any adjoining pipe trenches shall be as specified in Section 31 00 01 – Earthwork. Construct forms to the dimensions and elevations required. Forms shall be tight and well braced. Chamfer corners of forms. Prior to placing the concrete, remove all water and debris from the forms. Moisten forms just prior to placing the concrete. Handle concrete from the transporting vehicle to the forms in a continuous manner as rapidly as practical without segregation or loss of ingredients. Immediately after placing, compact concrete with a mechanical vibrator. Limit the duration of vibration to the time necessary to produce satisfactory consolidation without causing segregation. Screed the top surface of exposed slabs and walls. When the initial water has been absorbed, float the surfaces with a wood float and lightly trowel with a steel trowel to a smooth finish free from marks or irregularities. Finish exposed edges with a steel edging tool. Remove forms and patch any defects in the concrete with mortar mixed in the same proportions as the original concrete mix. Cure concrete by preventing the loss of moisture for a period of 7 days. Accomplish with a membrane-forming curing compound. Apply the curing compound immediately after removal of forms or finishing of the slabs. Protect concrete from damage during the 7-day curing period. If precast unit is used and material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean pit-run material. Set units to grade at locations shown. Set frames and grates at elevations indicated on Drawings. Frames may be cast in or shall be set in mortar.

D. Maintenance: In accordance with Article 3.01, temporary sediment basins and inlets shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Clean and repair basins and inlets such that they meet the specifications of Article 2.09 and minimize sediment transport. Remove sediment as necessary to provide adequate storage volume for subsequent rains.

## 2.11 TEMPORARY SOIL EROSION STABILIZATION (VEGETATIVE)

A. This section covers work necessary for temporary stabilization of soil to prevent erosion following clearing, grubbing, grading, or other construction, except wetlands. The Engineer may modify the use, location, and quantity of the areas requiring stabilization as considered being in the best interest of the Owner. Temporary stabilization within a buffer zone of Water of the United States shall meet the requirements of Article 1.08.

B. General Criteria: The stabilization measures specified herein shall be initiated on all disturbed areas including dikes and ditches within 24 hours of completion to minimize erosion and soil transport, provided however, that stabilization measures specified herein do not have to be initiated in the event that construction activities will resume on that portion of the site within 14 days from the date activities temporarily ceased. For cleared areas which may not receive permanent vegetative or other stabilization measure for 6 months or less AND a suitable growing season is not available for seedings to establish an erosion retardant cover, mulch may be applied according to the following specifications.

C. Material Specifications: Seed shall be clean, delivered in original unopened packages, and bearing an analysis of contents. Seed shall be guaranteed 95 percent pure with minimum germination rate of 85 percent. Seed mix shall be as shown in the Grassing Schedule (if included on the Erosion, Sedimentation, and Pollution Control Plan) or as directed by the GSWCC “Green Book”. Alternative seed mixes may be approved by the Engineer. Fertilizer shall be commercial, chemical type, uniform in composition, free-flowing, conforming to state and federal laws, and suitable for application with equipment designed for that purpose. Fertilizer rates shall be as shown in the Grassing Schedule (if included on the Erosion, Sedimentation, and Pollution Control Plan) or as directed by the GSWCC “Green Book”. Straw mulch shall be threshed straw of oats, wheat, or rye, free from obnoxious weed seeds or obnoxious weeds, or shall be clean hay. Average stalk length shall be 6 inches. Wood waste, asphaltic emulsion, or erosion control matting such as jute, excelsior, are appropriate for temporary stabilization. Asphaltic emulsion shall be CSS-1 as manufactured by Chevron Asphalt Company.

1. The Contractor shall submit to the Engineer certificates of inspection of seed by state or federal authorities and copies of delivery invoices or other documentation of quantities of mulch and fertilizer.

2. The Contractor shall give at least 3 days’ notice to the Engineer of the time and place of the planting of grass.

3. The Contractor shall keep the Engineer advised of his schedule of operations.

D. Application (Temporary Seeding): Planting and seeding shall be performed in accordance with the following requirements:

1. Soil Preparation: Prior to seeding operations, and after surface has been shaped, graded, and compacted, scarify surface to a minimum depth of 1 inch.

2. Seeding: All seedbeds shall be a minimum depth of 1 inch. Seedbeds shall be reviewed by the Engineer, prior to seeding. After soil has been scarified, apply required seed mix, uniformly with a hydro-seeder. Hydroseeding shall be as specified in Section 32 90 00 – Final Grading and Landscaping.

3. The required fertilizer mix shall be uniformly applied at the time of seeding. Fertilizer shall not be applied to a land area with a buffer zone of a Water of the United States.

4. Upon completion of the seeding operations, apply straw mulch to a reasonably uniform thickness of 1.5 to 2.5 inches in depth. Mulch shall be loose enough to permit penetration of sunlight and air circulation, but dense enough to shade ground, reduce evaporation rate, and prevent or materially reduce erosion of underlying soil. Retain straw in place by applying asphaltic emulsion at a rate of 100 gallons per acre or mechanically tack the mulch into the soil to approximately 3 inches. Equipment used for tacking shall be specially designed for this use. Mulch shall be paid for separately.

E. Application of Mulch only: For areas to receive mulch only, apply at the following rates, to the following depths, and according to the following specifications:

1. Dry Straw or Hay: Spread at a rate of 2.5 tons per acre. Apply to a depth of 6 to 10 inches. Apply uniformly and anchor as necessary.

2. Wood Waste: Spread at a rate of 6 to 9 tons per acre. Apply to a depth of 2 to 3 inches. Apply wood waste only on slopes that are 3:1 or flatter. Anchoring is not necessary.

3. Jute Matting or Excelsior Netting: Apply in accordance with manufacturer's recommendations.

4. Asphaltic Emulsion: Apply at a rate of 1,200 gallons per acre. Apply uniformly.

F. Maintenance: In accordance with Article 3.01, all stabilized areas shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Apply additional stabilization materials as needed.

G. Polyacrylamide Stabilization: This section covers the use of the chemical anionic polyacrylamide to settle out silt and suspend solids from surface water and ground water prior to discharge. Application of polyacrylamide shall utilize a method and amount as recommended by the manufacturer and approved by the Engineer. Anionic polyacrylamide may be applied to disturbed areas in either Powder or Liquid/Emulsion form as described herein.

1. Material Specifications: Anionic polyacrylamide shall be water soluble and non-toxic. All anionic polyacrylamide products, whether in Powder or Liquid/Emulsion form, shall meet the USEPA Grade 2 classification, "Generally Regarded as Safe (GRAS)." The Contractor shall submit Material Safety Data Sheets (MSDS) to the Engineer for approval of the anionic polyacrylamide. Handling and application of the product shall adhere to the MSDS requirements and recommendations.

2. Liquid/Emulsion form of anionic polyacrylamide shall be Applied Polymer Systems, Series 600, or equal. Powder form of anionic polyacrylamide shall be Applied Polymer Systems, Series 700, or equal. Specific polymer type used shall be as per manufacturer's recommendation for Cherokee County soil classifications.

3. Application: Liquid/Emulsion form of anionic polyacrylamide shall be applied to disturbed areas at a rate of 0.5 gallons of emulsion to 1,000 gallons of water. Powder form of anionic polyacrylamide shall be applied at a rate of 4 pounds per acre of disturbed area.

4. Maintenance: Apply additional anionic Polyacrylamide as authorized or directed by the Engineer.

## 2.12 STRAW WITH NET ROLLED EROSION CONTROL PRODUCT (RECP)

A. The Contractor shall place straw with net RECP in channels and on slopes as needed and as shown on the Drawings. The blanket shall consist of clean wheat straw from agricultural crops made into a knitted straw mat that is machine assembled. The straw shall be evenly distributed throughout the blanket. The blanket shall be covered with a photodegradable synthetic mesh net attached to the blanket with degradable thread.

B. The Contractor shall place the straw with net RECP in channels or slopes where directed immediately after the channel or slope has been properly graded and prepared, fertilized, and seeded. If the product is of single net construction, the net shall be on top with the straw blanket in contact with the soil.

C. The Contractor shall immediately repair or replace any section of straw with net RECP which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

D. Straw with net RECP shall be North American Green S150, American Excelsior Co. Curlex I, Contech SFB1, or equal with a minimum bare soil shear stress value of 1.5 $lb/ft^2$.

E. Unless otherwise shown or indicated on the Drawings, where RECP is shown or indicated for channel and/or slope matting, it shall be straw with net RECP, not curled wood or coconut fiber RECP.

## 2.13 CURLED WOOD OR COCONUT FIBER ROLLED EROSION CONTROL PRODUCT (RECP)

A. The Contractor shall place curled wood or coconut fiber RECP in channels and on slopes as needed and shown on the Drawings. The blanket shall consist of machine-produced curled wood excelsior or coconut fiber with a majority of the fibers 6 inches or longer with consistent thickness and the fibers evenly distributed over the entire area of

the blanket. The top of the blanket shall be covered with a biodegradable synthetic mesh net attached to the blanket with photodegradable synthetic yarn.

B. The Contractor shall place the curled wood or coconut fiber RECP where directed immediately after the channel or slope has been properly graded and prepared, fertilized, and seeded. If the product is of single net construction, the net shall be on top with the curled wood or coconut fiber blanket in contact with the soil.

C. The Contractor shall immediately repair or replace any section of curled wood or coconut fiber RECP which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

D. Curled wood or coconut fiber RECP shall be American Excelsior Curlex II, North American Green C125, Contech EFB4, or equal with a minimum bare soil shear stress value of 2.0 lb/ft$^2$.

## 2.14 SYNTHETIC TURF REINFORCEMENT MATTING (TRM)

A. The Contractor shall place synthetic channel and slope TRM in channel or on slopes as shown on the Drawings. The matting shall consist of entangled nylon, polypropylene, or polyester monofilaments mechanically joined at their intersections forming a three-dimensional structure. The matting shall be crush-resistant, pliable, water-permeable, and highly resistant to chemical and environmental degradation.

B. The Contractor shall place the synthetic TRM where directed immediately after the channel or slope has been properly graded and prepared.

C. After the TRM has been placed, the area shall be properly fertilized and seeded as specified allowing the fertilizer and seeds to drop through the net.

D. The Contractor shall immediately repair or replace any section of TRM which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

E. Synthetic TRM shall be Enkamat 7020 as manufactured by Colbond Geosynthetics, Synthetic Industries Landlock Erosion Mat TRM 1060, Miramat TM8 as manufactured by TC Mirafi, or equal matting with a minimum long-term vegetated shear stress value of 5.0 lb/ft$^2$.

## 2.15 TEMPORARY DOWNDRAIN STRUCTURES

A. Temporary downdrain structures shall be used to convey concentrated runoff down the face of a slope without causing erosion and shall generally be used in conjunction with temporary diversions. Temporary downdrain structures shall be designed, constructed, and maintained as shown on the Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in the GSWCC “Green Book”. The Contractor shall provide temporary downdrain structures with inlet and outlet protection and associated

diversion channels at all locations noted on the Drawings and other locations as may be directed by the Engineer.

B. Material Specifications: The pipe diameter for temporary downdrain structures shall be selected according to the GSWCC “Green Book”. The pipe shall be composed of heavy-duty flexible material such as non-perforated, corrugated plastic pipe or specially designed flexible tubing.

C. Construction

1. Place downdrain structures on undisturbed soil or well-compacted fill. Slightly slope the section of pipe under the dike toward its outlet. Hand-tamp the soil under and around the entrance section in lifts not exceeding 6 inches.

2. Ensure that all downdrain structure connections are watertight and that all fill material is well-compacted. Securely fasten the exposed section of the downdrain structure with grommets or stakes spaced no more than 10 feet apart. Extend the downdrain structure beyond the toe of the slope and provide outlet protection.

D. Maintenance

1. Inspect the temporary downdrain structure, inlet and outlet protection, and supporting diversions weekly and after every rainfall event and promptly make any necessary repairs. When the protected area has been permanently stabilized, temporary measures may be removed, materials disposed of properly, and all disturbed areas appropriately stabilized.

2. The temporary downdrain structures shall be maintained to the satisfaction of the Engineer until the site has been stabilized.

## 2.16 FILTER BAGS

A. Temporary filter bags for sediment control for use in dewatering and retaining sediment pumped out of active ‘dirty’ areas on the Project site, such as during the cleanout of sediment basins, dewatering of trenches, and during the implementation of stream restoration projects, where water is pumped from the work area, sent through the bag, and released from the bag to discharge on a stable floodplain or other secure area.

B. Material Specifications: The filter bag shall be made of nonwoven geotextile with a minimum surface area of 225 square feet per side and sewn with a double needle matching using a high strength thread. Each sack shall have a fill spout large enough to accommodate a 4-inch-diameter discharge hose.

C. The nonwoven geotextile fabric shall meet the following properties:

| Property | Units | Value | ASTM Test Method |
|---|---|---|---|
| Weight | ounces/yard | 12 | D3776 |
| Grab Tensile | pounds | 300 | D4632 |
| Puncture Resistance | pounds | 180 | D4833 |
| Flow Rate | gallons per minute per square foot | 75 | D4491 |
| Permittivity | 1/second | 1.1 | D4491 |
| Mullen Burst Strength | psi | 550 | D3786 |
| UV Resistance | percent | 70 | D4355 |
| Apparent Opening Size (Retained) | percent | 100 | D4751 |

D. Installation: Install filter bag on a slope so incoming water flows downhill through the filter bag without creating additional erosion. Tightly attach straps to the neck of the filter bag to secure the discharge hose and prevent pumped water from escaping without being filtered. To increase the efficiency of filtration, place the bag on a bed of aggregate or hay bales to maximize water flow through the surface area of the bag.

E. Maintenance

1. The filter bag shall be considered full when it can no longer efficiently filter sediment or pass water at a reasonable rate. Flow rates will vary depending on the size of the filter bag; the type and amount of sediment discharged into the filter bag; the type of ground, rock or other substance under the bag; and the degree of the slope on which the bag lies. Under most circumstances, filter bags shall accommodate flow rates of 1,500 gallons per minute. Use of excessive flow rates or overfilling filter bag with sediment that causes rupture of the bag or failure of the hose attachment straps is not acceptable. Damage and replacement costs for improper pumping shall be the responsibility of the Contractor.

2. Full or partially full filter bags cannot be left in place and shall be removed from the Project site and legally disposed of. If allowed, the filter bag may be cut open and the contents seeded after removing visible fabric. Filter bag shall be strong enough to be lifted with added straps. Off-site disposal may be facilitated by placing the filter bag in the back of a dump truck or flatbed prior to use and allowing the water to drain from the bag in place, thereby dismissing the need to lift the filter bag.

## 2.17 DEWATERING SUMPS

A. The Contractor shall install temporary dewatering sump pits and conduct pumping from these pits to remove excess water while minimizing sedimentation. The sump shall filter

the water being pumped to reduce sedimentation. Sedimentation may be reduced further when flow is pumped to a filter bag as indicated on the Drawings.

B. Material Specifications

1. Nonwoven Geotextile: Per Section 31 05 19 – Geotextiles

2. Stone: Clean #57 stone (0.75- to 1.5-inch-diameter maximum)

3. Hardware Cloth: 1/4-inch metal hardware cloth

4. Standpipe shall be 12- to 36-inch-diameter perforated pipe composed of high-density polyethylene, polyvinyl chloride, or corrugated metal per the Specifications and as required by Project site conditions and shall be provided with 1/2-inch x 6-inch slits or 1-inch-diameter holes located 6 inches on center. Bottom of pipe shall have a watertight cap or plate attached.

C. Installation

1. Excavate for pit construction. Pit dimensions shall be variable with the minimum diameter being twice the diameter of the standpipe.

2. A base of filter material consisting of clean gravel or #57 stone (1.5-inch-diameter maximum) shall be placed in the pit to a depth of 6 inches.

3. The standpipe shall be wrapped with hardware cloth and approved nonwoven geotextile fabric and placed in the pit on the filter material base.

4. After installing the standpipe, the surrounding pit shall then be backfilled with #57 stone to a minimum elevation of 6 inches above the anticipated high water level.

5. The standpipe shall extend a minimum of 12 inches above the anticipated standing water level.

6. Insert pumping mechanism and connect to separate filter bag if required by the Specifications or shown on the Drawings.

## PART 3 – EXECUTION

### 3.01 INSPECTIONS AND MAINTENANCE

A. The Contractor shall designate a Qualified Person to perform inspections required by this Section. The following areas are to be inspected and maintenance performed, if needed, at least once every 7 calendar days and within 24 hours of a rainfall event that has a precipitation of 1/2 inch or greater. Immediate action shall be taken to correct

deficiencies to BMPs. The Owner reserves the right to stop all construction activities not related to maintaining BMPs until such deficiencies are repaired.

1. Disturbed areas of the Project Site that have not undergone final stabilization

2. Erosion and sediment control structures

3. All locations where vehicles enter or exit the site

4. Material storage and construction laydown areas that are exposed to precipitation and have not been finally stabilized

B. In areas that have been finally stabilized, inspections and, if necessary, maintenance by Contractor shall occur at least once per month for the duration of the contract or project, whichever is longer.

C. During inspections, the following shall be observed and appropriate maintenance procedures taken:

1. The conformance to specifications and current condition of all erosion and sediment control structures

2. The effectiveness and operational success of all erosion and sediment control measures

3. The presence of sediments or other pollutants in stormwater runoff at all runoff discharge points

4. If reasonably accessible, the presence of sediments or other pollutants in receiving waters

5. Evidence of off-site tracking at all locations where vehicles enter or exit the site

D. The Contractor shall be responsible for preparation of the inspection reports as required by and in accordance with the requirements of the NPDES Permit. Completed inspection reports shall be kept on-site with the Contract Documents and submitted to the Engineer on a monthly basis. The Contractor shall repair deficiencies within 24 hours of inspection.

## 3.02 MONITORING AND REPORTING

A. Monitoring: The Contractor shall be responsible for the implementation of the monitoring program defined in the Plan as required by the NPDES Permit. The implementation must comply with EPD guidelines as set forth in the most recent version of the NPDES Permit.

B. Reporting: The Contractor shall prepare and submit a summary of the monitoring results to the Engineer and the EPD as required in the NPDES Permit (if the information is not required to be electronically submitted, it shall be submitted to: Mountain District –

Cartersville Office, Georgia Environmental Protection Division, 16 Center Road, Cartersville, GA 30120, 770.387.4900). The Owner reserves the right to use its own resources to duplicate monitoring and verify the work required by the Contractor under this Section.

C. The Contractor shall provide and pay for stormwater outfall sampling and analytical testing as described on the Drawings and as may be required by the NPDES Permit.

## 3.03 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

A. At such time that temporary erosion and control structures are no longer required under this item, the Contractor shall notify the Engineer of its intent and schedule for the removal of the temporary structures and obtain the Engineer's approval in writing prior to removal. Once the Contractor has received such written approval from the Engineer, the Contractor shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded as specified in Section 32 90 00 – Final Grading and Landscaping.

## 3.04 NOTICE OF TERMINATION

A. When all construction activities have ceased, final stabilization has been implemented by the Contractor, and the site is in compliance with the NPDES Permit, the Contractor shall electronically complete and submit a Notice of Termination to Georgia EPD through GEOS in accordance with the requirements of the NPDES Permit. Submittal shall be coordinated with Owner and Engineer.

**END OF SECTION**

## SECTION 32 10 00
## PAVING AND SURFACING

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment and materials and perform all operations in connection with the construction of asphalt concrete pavement, asphalt concrete overlay, reinforced concrete pavement, gravel roads, concrete curb and gutter, repair and reconstruction of existing asphalt concrete pavement, asphalt milling, repair of existing gravel roads, and pavement markings complete as specified herein and as detailed on the Drawings.

B. All new roads including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt and/or gravel, depending upon the material encountered, unless otherwise indicated.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 01, Division 02 and Division 03 of these Specifications.

### 1.03 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete

B. Section 31 00 01 – Earthwork

### 1.04 REFERENCES

A. Georgia Department of Transportation Standard Specifications Construction of Transportation Systems and Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems (GDOT Standard Specifications), latest edition

### 1.05 STANDARD SPECIFICATIONS

A. Except as otherwise provided in the Specifications or on the Drawings, all work shall be in accordance with the GDOT Standard Specifications except that any reference to "GDOT", "Department" or "Unit" shall mean the "Owner".

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B. Except with the approval of the Engineer, the placing of concrete or asphalt concrete surface paving shall be subject to the Seasonal and Weather Restrictions set forth in GDOT Standard Specifications.

## PART 2 – MATERIALS

### 2.01 SELECT FILL

A. The Contractor shall place select fill as necessary to complete the embankments, shoulders, subgrade foundation and replacement for removed unsuitable material in accordance with GDOT Standard Specifications and Section 31 00 01 – Earthwork.

### 2.02 GRAVEL

A. All work, including materials, associated with gravel shall be in accordance with GDOT Standard Specifications Section 800 – Coarse Aggregate.

### 2.03 AGGREGATE STABILIZATION

A. All work, including materials, associated with Aggregate Stabilization shall be in accordance with GDOT Standard Specifications Section 803 – Stabilizer Aggregate.

### 2.04 GRADED AGGREGATE BASE (GAB)

A. All work, including materials, associated with GAB shall be in accordance with GDOT Standard Specifications Section 815 – Graded Aggregate.

### 2.05 ASPHALT CEMENT

A. All work, including materials, associated with asphalt cement shall be in accordance with GDOT Standard Specifications Section 820 – Asphalt Cement, Grade PG 64-22 or PG 67-22.

### 2.06 ASPHALT PAVEMENTS

A. All work, including materials, associated with asphalt pavement shall be in accordance with GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction. Surface Course shall be 12.5-mm Superpave, Intermediate Course shall be 19-mm Superpave, and Base Course shall be 25-mm Superpave. Asphalt pavement mix designs shall be in accordance with GDOT Standard Specifications Section 828 – Hot Mix Asphaltic Concrete Mixtures.

B. The job mix formulas shall be delivered to the Engineer at least 2 weeks prior to beginning paving operations.

## 2.07 RIGID PORTLAND CEMENT CONCRETE PAVEMENT

A. All work, including materials associated with rigid concrete pavement shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. Class A concrete shall be used. Placement shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete and GDOT Standard Specifications Section 430 – Portland Cement Concrete Pavement.

## 2.08 RIGID CONCRETE PAVEMENT REINFORCING

A. Reinforcing, if specified, shall be as shown on the Structural Drawings and as specified under Section 03 21 00 – Reinforcing Steel.

## 2.09 CONCRETE CURB AND GUTTERS

A. Concrete shall be Class B in accordance with the requirements of Section 03 30 00 – Cast-in-Place Concrete, except that concrete shall be air-entrained to provide an air content of 6%+/-1.5%.

B. Premolded expansion joint filler for expansion joints shall conform to ASTM D1751 and shall be 1/2 inch thick, minimum.

## 2.10 ASPHALT TACK COAT

A. All work, including materials, associated with asphalt tack coat shall be in accordance with GDOT Standard Specifications Section 413 – Bituminous Tack Coat.

## 2.11 POLYCYCLIC AROMATIC HYDROCARBON (PAH)

A. The EPA has classified 7 PAHs as probable human carcinogens, and 16 PAHs as Priority Pollutants. Materials containing concentrations of PAH, such as Coal Tar Based Sealcoat, higher than allowed by OSHA limits shall not be allowed for use on the project.

# PART 3 – EXECUTION

## 3.01 EMBANKMENT

A. The embankment shall be constructed in accordance with Section 31 00 01 – Earthwork.

## 3.02 SUBGRADE

A. The subgrade, where shown on the Drawings, shall be aggregate stabilized by the addition and mixing of coarse aggregate with the top 6 inches of subgrade in accordance with GDOT Standard Specifications Section 209 – Subgrade Construction. Aggregate stabilization shall be applied to the subgrade at a rate of 300 pounds per square yard. Following the application of stabilizer aggregate, the subgrade shall be formed true to crown and grade and shall be compacted with a minimum of four passes of a 15-ton

vibratory roller to conform to the maximum densities determined by AASHTO T99 Standard Specifications.

## 3.03 BASE COURSE

A. The finished base course of all paving shall be GAB and shall be of the thickness shown on the Drawings, formed true to crown and grade. Gravel roads, including repair to existing gravel roads shall be GAB and shall be of the thicknesses shown on the Drawings, formed true to crown and grade. No fill material except new GAB shall be placed on top of existing gravel.

## 3.04 ASPHALT BASE COURSE (OR INTERMEDIATE COURSE)

A. Asphalt Concrete Base (or Intermediate) Course shall meet the requirements of 25-mm Superpave (19-mm Superpave for Intermediate) and be placed in lifts with a minimum thickness of 2.5 inches (1.75 inches for Intermediate) and a maximum thickness of 5 inches (3 inches for Intermediate). Asphalt Concrete Base (or Intermediate) Course shall be compacted in accordance with GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction. Thicknesses shall be as shown on the Drawings.

## 3.05 ASPHALT CONCRETE SURFACE COURSE

A. Prior to placement of the asphalt concrete surface course, the base/intermediate course shall be inspected for damage or defects and repaired to the satisfaction of the Engineer. The surface of the base/intermediate course shall be approved by the Engineer.

B. The asphalt tack coat shall be applied to the surface of the approved base/binder course as described in GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction. Equipment for applying the tack coat shall be power-oriented pressure spraying or distributing equipment suitable for the materials to be applied and approved by the Engineer.

C. The Asphalt Concrete Surface Course shall meet the requirements of 12.5-mm Superpave and be placed and compacted on the base/intermediate course in layers with a minimum thickness of 1.375 inches and a maximum thickness of 2.5 inches. Surface Course shall be compacted in accordance with GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction. Thicknesses shall be as shown on the Drawings.

## 3.06 ASPHALT CONCRETE PAVEMENT COMPACTION

A. Asphalt concrete pavement compaction shall be performed as per GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction.

B. Contractor shall provide Quality Control (QC) for proper asphalt concrete pavement placement and compaction using equipment in good working order which has been properly calibrated at the start of each round of testing. Quality Assurance (QA) of paving operations will be performed by an independent third-party Materials Testing Consultant hired and paid by Owner.

C. Immediately after the asphalt mixture has been spread, struck off and surface and edge irregularities adjusted, thoroughly and uniformly compact the pavement. Compact the mix to the required degree of compaction per GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction.

## 3.07 ASPHALT CONCRETE DENSITY ACCEPTANCE

A. The Engineer will evaluate the asphalt pavement for density acceptance after the asphalt mix has been placed and compacted using the Contractor's QC test results, the Owner’s QA test results (including verification samples) and by observation of the Contractor's density QC process conducted in accordance with GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction.

B. Minimum density requirements for all mixes shall be as specified in GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction. Density acceptance shall be as provided herein. Core sample shall be obtained and tested by the Owner’s representative at the same frequency and location as the Contractor’s QC testing, if possible, and densities will be determined by the procedures identified in GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction.

C. A failing lot for density acceptance purposes is defined as a lot for which the average of all test sections, and portions thereof, fails to meet the minimum specification requirement. A lot shall consist of one day’s production of a given JMF, for each layer of asphalt concrete placed. If additional density sampling and testing, beyond the minimum requirement, is performed and additional test sections are thereby created, then all test results shall be included in the lot average.

D. Any lot or portion of a lot deemed obviously unacceptable by the Owner or Engineer will be rejected for use in the work. If the Engineer determines that a given lot of mix does not meet the minimum specification requirements, but the work is reasonably acceptable, the lot will be accepted at a reduced pay factor in accordance with Table 13 in GDOT Standard Specifications Section 400 – Hot Mix Asphaltic Concrete Construction. The reduced pay factor will apply only to the Contractor’s schedule of values.

## 3.08 ASPHALT CONCRETE PAVEMENT PHASING

A. Contractor shall be responsible for phasing the placement of asphalt concrete pavement sections and courses to account for individual construction activities, the construction traffic volume, and vehicle loading expected throughout construction activities. The

placement of asphalt concrete pavement shall also be phased so the GAB, once installed, is not exposed to freeze/thaw cycles.

## 3.09 RIGID PORTLAND CEMENT CONCRETE

A. The subgrade and base course beneath portland cement concrete pavement shall be prepared in accordance with the applicable Sections of these Specifications and referenced Standard Specifications, except that the Contractor shall use an approved automatically controlled fine grading machine to produce final subgrade and base surfaces meeting the lines, grades, and cross sections (thicknesses) shown on the Drawings or established by the Engineer.

B. The surface of the base shall be damp at the time the concrete is placed. The Contractor shall sprinkle the base when necessary to provide a damp surface. The Contractor shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.

C. Hauling over the base course shall not be allowed except where specifically permitted by and in writing by the Engineer. The Engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions the Engineer deems necessary to facilitate placing and spreading the concrete.

D. Installation of the rigid concrete pavement shall be in accordance with the details shown on the Drawings and Division 03 – Concrete. The rigid concrete pavement shall cure a minimum of 10 calendar days and until the concrete has attained a minimum flexural strength of 550 psi as indicated by flexural strength testing. The Contractor shall coordinate and pay for all flexural strength testing with a minimum of four 6-inch by 6-inch by 20-inch beams for every 50 cubic yards of pavement concrete installed.

E. Transverse and longitudinal joints shall be spaced at intervals as shown on the Drawings and installed as per the requirements of GDOT Standard Specifications Section 430 – Portland Cement Concrete Pavement. Transverse contraction joints shall be formed by an approved joint insert. Longitudinal joints shall be formed by allowing the paver to deposit the mixture adjacent to the joint to such depth that maximum compaction can be obtained along the joint. Pinch the joint by rolling immediately behind the paver. Expansion joints shall be placed when the pavement abuts a structure using 1-inch expansion joint material (filler) and sealant as specified herein.

## 3.10 CONCRETE CURB AND GUTTER AND SIDEWALK

A. The expansion joint filler for concrete curb and gutters shall be cut to conform with the cross section of the curb. Expansion joints shall be spaced at intervals of not more than 50 feet. Formed control joints shall be installed at intervals not exceeding 10 feet. (Expansion joints can placed at intervals of 45 feet and control joints at 15 feet if curb and gutter is machine placed.) Depth of joint shall be 1/3 the thickness. Curved forms shall be used where radii are indicated; straight segments shall not be permitted. Upon removal of the forms, exposed curb faces shall be immediately rubbed down to a smooth and uniform surface. No plastering shall be permitted.

B. Concrete sidewalks shall include contraction joints between each panel of sidewalk and when sidewalk width exceeds 6 feet, longitudinal contractions joints shall be placed as required. Additionally, 1/2-inch expansion joints and sealer shall be placed at a maximum spacing of 50 feet of sidewalk. 1/2-inch expansion joint material and sealer shall also be where sidewalks abut and rigid structure or curb and gutter.

## 3.11 UNDERGROUND UTILITY LINES

A. Where an underground utility line is beneath the new roadway, the backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of the roadway over the trench shall be deferred as long as practicable.

## 3.12 JUNCTION WITH OTHER PAVING

A. Where new asphalt concrete pavement abuts existing asphalt concrete pavement, the existing pavement shall be cut back to ensure obtaining the specified compaction of the new pavement courses and interlocking adjoining courses. Existing subbase courses shall be cut back from the subgrade level of the new pavement on a one-on-one slope into the existing pavement, and the asphalt courses of the existing pavement shall be removed for an additional 6 inches back from the slope. The edge of the existing asphalt courses shall be saw cut straight and true. The faces between new and existing asphalt courses shall receive an application of tack coat.

B. Where new rigid concrete pavement abuts existing rigid concrete or asphalt concrete paving, the existing paving shall be saw cut straight and true. An expansion joint of a 1/2-inch minimum thickness with filler material and sealant shall be placed between the new concrete pavement and the existing rigid concrete or asphalt concrete paving.

## 3.13 ASPHALT MILLING

A. Areas where asphalt milling is indicated on the Drawings shall be milled in accordance with GDOT Standard Specifications Section 432 – Mill Asphaltic Concrete Pavement.

## 3.14 ASPHALT CONCRETE OVERLAY

A. Where asphalt concrete is proposed to be placed over a milled asphalt, existing asphalt or rigid concrete surface, the surfaces shall be thoroughly cleaned by power brooming and a tack coat shall be applied in accordance with GDOT Standard Specifications Section 413 – Bituminous Tack Coat prior to installing the overlay. The overlay shall be applied in accordance with Articles 2.06 and 3.05 and the Standard Details shown on the Drawings.

**END OF SECTION**

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# SECTION 32 11 00
# SURFACE RESTORATION

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Provide all labor, equipment, and materials necessary for final grading, topsoil placement, and miscellaneous site work not included under other Sections but required to complete the work as shown on the Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

B. Section 31 25 00 – Erosion and Sedimentation Control

C. Section 32 90 00 – Final Grading and Landscaping

## PART 2 – MATERIALS

### 2.01 TOPSOIL

A. Topsoil shall meet the requirements of Section 31 00 01 – Earthwork.

## PART 3 – EXECUTION

### 3.01 FINAL GRADING

A. Following approval of rough grading the subgrade shall be prepared as follows:

1. For riprap, bare soil 24 inches below finish grade or as directed by Engineer.

2. For topsoil, scarify 2 inches deep at 4 inches below finish grade.

### 3.02 TOPSOIL PLACEMENT

A. Topsoil shall be placed over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped.

B. Topsoil shall be spread in place for lawn and road shoulder seed areas at a 4-inch consolidated depth and at a sufficient quantity for plant beds and backfill for shrubs and trees.

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C. Topsoil shall not be placed in a frozen or muddy condition.

D. Final surface shall be hand or mechanically raked to an even finished surface to finish grade as shown on Drawings.

E. All stones, roots over 4 inches, rubbish, and other deleterious materials shall be removed and disposed of.

**END OF SECTION**

# SECTION 32 90 00
# FINAL GRADING AND LANDSCAPING

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all labor, equipment, and materials necessary for final grading, topsoiling, seeding, and miscellaneous site work not included under other Sections, but required to complete the work as shown on the Drawings and specified herein. Under this Section, all areas of the Project Site disturbed by excavation, materials storage, temporary roads, etc., shall be reseeded as specified herein.

B. Final grading and landscaping shall generally comply with the requirements of the Manual for Erosion and Sediment Control in Georgia (the "Green Book"), 2016 Edition or latest update, as adopted by the Georgia Soil and Water Conservation Commission (GSWCC). The requirements specified herein and shown on the Drawings are minimum requirements for final grading and landscaping. Requirements set forth in the latest edition of the GSWCC "Green Book" shall govern over the requirements herein in case of conflicting information, unless clearly identified as a deviation from the GSWCC "Green Book".

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

B. Section 31 25 00 – Erosion and Sedimentation Control

C. Section 32 11 00 – Surface Restoration

### 1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Product Data

2. Certification of all materials

3. Three copies of soils test report with fertilizer recommendation from the Cherokee County UGA (University of Georgia) Extension Office, a partnership with the United States Department of Agriculture

4. Three copies of composition and germination certification and of test results for grass seed

## PART 2 – PRODUCTS

### 2.01 CONTRACTOR'S RESPONSIBILITIES

A. Furnish and submit certification for the materials used as specified in the General Conditions, as modified by the Supplementary Conditions, Division 01, and Division 02.

### 2.02 TOPSOIL

A. Upon completion and approval of the rough grading, the Contractor shall place the topsoil over all areas disturbed during construction under any contract except those areas which will be paved, graveled, rip rapped, or otherwise covered with an impervious surface. Topsoil shall be tested and amended as necessary according to the requirements of Section 31 00 01 – Earthwork prior to being placed over the site. Topsoil shall not be placed in a frozen or muddy condition and shall contain no toxic materials harmful to grass growth.

### 2.03 WATER

A. Water shall be furnished to the Contractor by the Owner from existing facilities as directed by the Engineer.

B. The Contractor shall furnish all hoses and connections necessary to complete the landscaping work.

### 2.04 FERTILIZER

A. Fertilizer shall be a complete commercial fertilizer with components derived from commercial sources. Fertilizer analysis shall be determined from field soil sampling in appropriate number taken by the Contractor and analyzed by the Cherokee County UGA Extension Office or other independent laboratory. Contractor shall furnish fertilizer in accordance with the recommendations of the Cherokee County UGA Extension Office.

B. One-quarter of the Nitrogen shall be in the form of nitrates, one-quarter in the form of ammonia salts, and one-half in the form of natural organic Nitrogen. Available Phosphoric Acid shall be free from superphosphate, bone, or tankage. Potash shall be Sulphate of Potash. Elements shall conform to the standards of the Association of Official Agricultural Chemists.

C. Fertilizer shall be delivered in standard size bags marked with the weight, analysis of contents, and the name of the manufacturer. Fertilizer shall be stored in weatherproof storage areas and in such a manner that its effectiveness will not be impaired.

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## 2.05 LIME

A. At least 50% shall pass a No. 200 U.S.S. mesh sieve. At least 90% shall pass a No. 100 U.S.S. mesh sieve and 100% shall pass a No. 10 U.S.S. mesh sieve. Total carbonates shall not be less than 80% or 44.8% Calcium Oxide equivalent. For the purpose of calculation, total carbonates shall be considered as Calcium Carbonate.

## 2.06 GRASS SEED

A. The Contractor shall furnish the kinds and amounts of temporary and permanent seed to be planted in all areas disturbed by the construction work. All seed shall be labeled to show that it meets the requirements of the Georgia Seed Law. All seed must have been tested within 6 months immediately preceding the planting of such material on the job.

B. Contractor may submit alternate grass seed types, rates, and planting dates specific to the Project Site based on consultation with, and the recommendations of, the Cherokee County UGA Extension Office, a local Soil Conservation District, or other qualified organization for approval by the Engineer before planting.

C. The inoculant for treating legume seed shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species. Inoculants shall not be used later than the date indicated on the container. The quality of the seed shall be determined by calculating the pure live seed (PLS), which is a percentage of the seeds that are pure and will germinate, per the GSWCC “Green Book”. PLS rates shall conform to the appliable tables in the GSWCC “Green Book”.

D. All seed shall be in conformance with Georgia Seed Law restrictions for restricted noxious weeds.

E. Seed mixtures to be used on the Project Site shall conform to the GSWCC “Green Book”.

## 2.07 WOOD CELLULOSE FIBER MULCH

A. For use in hydroseeding grass seed in combination with fertilizers and other approved additions, shall consist of especially prepared wood cellulose fibers such as "Wood-Lok 300" manufactured by Applegate Mulch, "Enviro-Mix" manufactured by Profile, or equal, and have no growth or germination inhibiting factors, and be dyed green.

B. The wood cellulose fiber shall have the additional characteristic of dispersing rapidly in water to form a homogeneous slurry and remain in such state when agitated in the hydraulic mulching unit, or adequate equal, with the specified materials.

C. When applied, the wood cellulose fiber with additives shall form an absorptive mat but not a plant inhibiting membrane, which shall allow moisture, natural or mechanical, to percolate into underlying soil.

D. The mulch shall be supplied, compressed in packages containing 50 pounds of material having an equilibrium air dry moisture content at time of manufacture of 12% +/-3%. Wood cellulose fiber mulch shall be stored in a weatherproof storage area and in such a manner that effectiveness will not be impaired.

## 2.08 STRAW MULCH

A. Straw mulch shall be spread manually or by use of a straw blower. Straw used for mulch shall be small grain hay. Hay shall be undamaged, air dry, threshed straw, free of undesirable weed seed. Straw mulch is not required for seeded areas treated by hydroseeding or with a temporary soil stabilizer.

B. Tackifier for securing straw mulch shall be Contact AT manufactured by Profile Products, M-Binder manufactured by Granite Seed, or Lawn Tack as manufactured by Rhino, or approved equal.

## 2.09 TEMPORARY SOIL STABILIZER

A. Temporary soil stabilizers may be used in place of temporary seeding, as approved by the Owner or Engineer. The temporary agent for soil erosion control shall consist of an especially prepared plant-based or cementitious highly concentrated powder which, when mixed with water, forms a thick liquid such as "DustOut" manufactured by DustOut™, "Stabilizer" manufactured by Stabilizer Solutions, or "SoiLok™" as manufactured by Prime Resins, or equal, and having no growth or germination inhibiting factors. The agent shall be used for bare soil stabilization or hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a wind and rain resistant crust.

## 2.10 ROLLED EROSION CONTROL PRODUCTS

A. The rolled erosion control products (RECPs) shall be as specified in Section 31 25 00 – Erosion and Sedimentation Control.

## 2.11 RIPRAP AND HERBICIDES

A. Furnish and install sufficient quantity of landscape gravel or riprap to cover over the ground to a minimum 4-inch depth for gravel and 24-inch depth for riprap, unless otherwise noted, or indicated on the Drawings. Also furnish and apply an approved herbicide to the subgrade surface just prior to installing the landscape gravel or riprap.

B. During placing, the stone shall be graded so that the smaller stones are uniformly distributed through the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone.

C. All topsoil and vegetative matter shall be removed from the subgrade surfaces prior to the application of the weed killer (herbicide) and to the placement of landscape gravel or

riprap. Apply commercial-type herbicide as preemergence control of miscellaneous grasses and broadleaf weeds in granular or liquid form such as "Treflan", "Dymid", or equal. Methods and rates of application shall be in strict compliance to manufacturer's directions and acceptable to the Engineer.

D. The herbicide selected shall be safe for use around ornamental plantings, have long-lasting weed control, and shall be resistant to leaching away under excessive rainfall.

E. A second application of the herbicide shall be made on the surface of the landscape gravel or riprap sometime after the first 6 months, but not later than 12 months. Same methods and rates apply as specified previously.

## PART 3 – EXECUTION

### 3.01 GRADING

A. After approval of the rough grading, the Contractor shall commence preparations of the subgrade for the various major conditions of the work as follows:

1. Bare soil for riprap area at subgrade (24 inches below final grade, or as directed by the Engineer).

2. Topsoil for lawn and road shoulder seed area - scarify 2-inch depth of subgrade (4 inches below final grade) prior to placing topsoil.

B. Final surface grading of the top-soiled, landscape graveled, and riprapped areas shall be mechanically raked or hand raked to an even finished surface alignment.

### 3.02 TOPSOIL

A. Topsoil shall be spread in place for quantity required for lawn and road shoulder seed areas at 4-inch consolidated depth, and sufficient quantity for certain plant beds and backfill for shrubs and trees as specified.

### 3.03 SEEDBED PREPARATION

A. Contractor shall prepare all areas to receive temporary or permanent seeding measures prior to planting.

B. Topsoil shall be placed in areas to be seeded and roughened with tracked equipment or other suitable measures. Slopes steeper than 3:1 may be roughened by grooving, furrowing, tracking, or stairstep grading. Slopes flatter than 3:1 should be grooved by disking, harrowing, raking, operating planting equipment on the contour.

C. Soil amendments including, but not limited to, lime and fertilizer shall be spread as necessary, and at the rates specified in this Section. Seeding shall be as per the type

and rates specified in this Section. Seed shall be broadcast as soon as possible following roughening and before surface has been sealed by rainfall.

## 3.04 GRASS ESTABLISHMENT AND HYDROSEEDING

A. Prepare of the topsoil and bare soil seed bed, applicate fertilizer, limestone, mulching, inoculant, temporary soil stabilizer, water, and all other operations necessary to provide a satisfactory growth of grass at the end of the 1-year maintenance period. Areas without satisfactory grass at the end of 1 year shall be replanted until satisfactory growth is obtained and acceptable to the Engineer.

B. For areas to be seeded by the hydraulic seeding method, include all additives and amendments required. a "Reinco", "Finn", or "Bowie" type hydromulcher with adjustable nozzles and extension hoses, or equal, shall be utilized. The general capacity of tank should range from 500 to 2,500 gallons, or as approved by the Engineer.

C. Hydraulic seeding shall be carried out in three steps. Step one shall consist of the application of lime. In step two the seed mixture shall be mixed with the fertilizer, wood cellulose fiber mulch, and any required inoculants and applied to the seed bed. Step three shall consist of an application of top dressing during the first spring or fall, whichever comes first, after step two.

D. Top dressing shall consist of a commercial grade fertilizer plus Nitrogen or other analysis as may be recommended by soil testing. Contractor shall submit results of soils testing and recommendations to Engineer for review before applying top dressing. Types and application rates of seed mixtures, lime, fertilizer, and wood cellulose fiber mulch shall be as shown in the Seeding Schedule.

E. Ingredients for the mixture and steps should be dumped into a tank of water and thoroughly mixed to a homogeneous slurry and sprayed out under a minimum pressure as recommended by the Manufacturer, in suitable proportions to accommodate the type and capacity of the hydraulic machine to be used. Applications shall be evenly sprayed over the ground surface. The Contractor shall free the topsoil of stones, roots, rubbish, and other deleterious materials and dispose of same off the site. The bare soil, except existing steep embankment area, shall be rough raked to remove stones, roots, and rubbish over 4 inches in size, and other deleterious materials and dispose of same off the site.

F. No seeding should be undertaken in windy or unfavorable weather, when the ground is too wet to rake easily, when it is in a frozen condition, or too dry. Any bare spots shown in 2 to 3 weeks shall be recultivated, fertilized at half the rate, raked, seeded, and mulched again by mechanical or hand broadcast method acceptable to the Engineer.

G. Areas that have been manually seeded or hydroseeded with a temporary seed mixture shall be mowed to a height of less than 2 inches and scarified prior to hydroseeding with the permanent seed mixture.

H. The Contractor shall provide, at the Contractor's own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.

I. The Contractor shall water newly seeded areas of the lawn and road shoulder mix once a week until the grasses have germinated sufficiently to produce a healthy turf (a minimum of 80% ground coverage), or unless otherwise directed by the Engineer. Each watering shall provide 3 gallons per square yard. The Contractor shall furnish all necessary hoses, sprinklers, and connections.

J. The first and second cutting of the lawn grasses only shall be done by the Contractor. All subsequent cuttings will be done by the Owner's forces in a manner specified by the Contractor.

## 3.05 DITCH AND SWALE EROSION PROTECTION

A. All ditches and swales indicated on the Drawings shall be lined with a rolled erosion control product (RECP). The area to be covered shall be properly graded and hydroseeded before the RECP is installed. Installation shall be in accordance with Section 31 25 00 – Erosion and Sedimentation Control.

## 3.06 MAINTENANCE

A. The Contractor shall be responsible for maintaining all seeded areas through the end of a 1-year warranty period, beginning from the date of acceptance of final seeding and landscaping as determined by the Engineer. Maintenance shall include but not be limited to, annual fertilization, mowing, repair of seeded areas, irrigation, and weed control. The Contractor shall provide, at the Contractor's own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.

B. Annual fertilization shall consist of an application of 500#/acre of 10-10-10 commercial grade fertilizer, or its equivalent and 60#/acre of nitrogen in early fall, or other analysis as may be determined by soil test. Annual fertilization shall be in addition to top dressing and shall be performed by the Contractor each fall season after planting until the work is substantially complete.

C. Mowing shall be scheduled to maintain a minimum stand height of 4 inches or as directed by the Engineer. Stand height shall be allowed to reach 8 to 10 inches prior to mowing.

D. All seeded areas shall be inspected on a regular basis and any necessary repairs or reseedings made within the planting season, if possible. If the stand should be over 20% damaged, it shall be re-established following the original seeding recommendations.

E. Weed growth shall be maintained mechanically and/or with herbicides. When chemicals are used, the Contractor shall follow the current UGA Agricultural Experiment Stations' weed control recommendations and adhere strictly to the instructions on the label of the herbicide. No herbicide shall be used without prior approval of the Engineer.

## 3.07 CLEANUP

A. The Contractor shall remove from the site all subsoil excavated from their work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

B. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

## 3.08 SEEDING SCHEDULE

A. All seeding and mulching to be completed by the Contractor shall conform to the schedules in the GSWCC “Green Book”. No permanent seeding shall be performed from June 1 through August 31. Temporary seed mixtures must be used during these times if seeding is necessary. Areas seeded with temporary seed mixtures shall be reseeded by the Contractor at no additional cost to the Owner with permanent seed as directed by the Engineer.

B. Application rates of seed mixtures, lime, fertilizer, mulch and top dressing shall conform to the requirements of the GSWCC “Green Book”.

**END OF SECTION**

## SECTION 33 05 61
## UTILITY STRUCTURES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery and installment of utility structures and appurtenances in accordance with the Drawings and as specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 21 00 – Reinforcing Steel

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 03 60 00 – Grout

D. Section 04 05 13 – Mortar and Masonry Grout

E. Section 05 05 23 – Metal Fastening

F. Section 05 56 00 – Castings

G. Section 31 00 01 – Earthwork

H. Section 33 24 00 – Storm Drains and Roof Drains

I. Section 40 05 00 – Basic Mechanical Requirements

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C32 – Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)

2. ASTM C139 – Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

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3. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

4. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

5. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

6. ASTM C858 – Standard Specification for Underground Precast Utility Structures

7. ASTM C890 – Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

8. ASTM C913 – Standard Specification for Precast Water and Wastewater Structures

9. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

10. ASTM C990 – Standard Specifications for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

11. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

12. ASTM C1478 – Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals

13. ASTM C1802 – Standard Specification for Design, Testing, Manufacture, Selection, and Installation of Horizontal Fabricated Metal Access Hatches for Utility, Water, and Wastewater Structures

14. ASTM F2510 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes

15. ASCE/SEI 7-16 – Minimum Design Loads and Associated Criteria for Buildings and other Structures

## 1.04 SUBMITTALS

A. Submit samples and/or Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings shall include, but not be limited to:

1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.

2. Complete layout and installation Drawings and schedules with clearly marked dimensions.

3. Material certificates on all piping materials.

4. A list of the design criteria used by the manufacturer for all manufactured, precast items.

5. Structural design calculations sealed by a Professional Engineer registered in the state of Georgia. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater full height of structure. The factor of safety for buoyancy due to groundwater conditions as noted above shall be 1.25. Factors of safety for other design conditions shall be as per ASCE 7-16, Section 4.2 - Safety Factors.

6. Certified reports for all lifting inserts, indicating allowable design loads.

7. Information on lifting and erection procedures.

8. Results of leakage test

## PART 2 – PRODUCTS

### 2.01 PRECAST MANHOLES AND UTILITY STRUCTURES

A. Design requirements vary for manholes, for utility structures exposed to internal liquid, and for utility structures not exposed to internal liquid, as follows:

1. All precast manholes exposed to internal liquid shall conform to the following requirements:

a. Precast manholes shall conform to the requirements of ASTM C478 and shall be designed for loads in accordance with ASTM C890.

b. Precast manholes shall be watertight for infiltration and exfiltration. Joints between manhole riser sections and at base slabs shall conform to the requirements of ASTM C443.

c. Manhole section shall have an internal diameter of 4.00 feet, unless noted otherwise. Clear lid openings shall be minimum of 24-inch diameter.

2. Precast utility structures exposed to internal liquid (other than manholes) shall include but not be limited to water and wastewater distribution boxes, yard inlets, and catch basins. These structures shall conform to the following requirements:

    a. Precast utility structures exposed to internal liquid (other than manholes) shall conform to the requirements of ASTM C913 and shall be designed for loads in accordance with ASTM C890.

    b. Precast utility structures exposed to internal liquid shall be watertight for infiltration and exfiltration. Joints between riser sections and at base slabs shall conform to the requirements of ASTM C443.

3. Precast utility structures not exposed to internal liquid (other than manholes) shall include but not be limited to vaults and meter boxes for piping, and utility structures for electric, gas, or communication lines. These structures shall conform to the following requirements:

    a. Precast utility structures not exposed to internal liquid (other than manholes) shall conform to the requirements of ASTM C858 and shall be designed for loads in accordance with ASTM C857.

    b. Precast utility structures not exposed to internal liquid shall be soil-tight and shall be watertight for infiltration when below groundwater. Joints between riser sections and at base slabs shall conform to the requirements of either ASTM C443 or ASTM C990.

B. In addition to the requirements above, the following requirements are typical for all precast manholes and utility structures:

1. Precast manholes and utility structures shall be furnished with sleeves and openings as noted on the Drawings, conforming accurately to the sizes and elevations of the adjoining pipes or conduits.

2. Precast manholes and utility structures shall include ballast concrete and/or other means necessary to ensure they resist flotation when empty and subjected to groundwater full height of structure.

3. Precast manholes and utility structures shall be as manufactured by Oldcastle, Tindall Corporation, or equal.

4. The date and name of manufacturer shall be marked inside each precast section.

5. No more than two lift holes may be cast or drilled in each section.

6. Dimensions shall be as shown on the Drawings.

7. Covers and frames shall be as specified in Article 2.11.

8. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.

## 2.02 BRICK

A. Brick shall be sound, hard-burned common brick conforming to ASTM C32, Grade MS.

## 2.03 MORTAR

A. Mortar shall conform to Section 04 05 13 – Mortar and Masonry Grout.

## 2.04 CONCRETE

A. Concrete shall conform to Section 03 30 00 – Cast-in-Place Concrete.

## 2.05 REINFORCING

A. Reinforcing shall conform to Section 03 21 00 – Reinforcing Steel.

## 2.06 CONCRETE BLOCK

A. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C139.

## 2.07 CASTINGS

A. Castings shall conform to Section 05 56 00 – Castings. Casting shall be of the type and size indicated on the Drawings.

## 2.08 STEPS

A. Steps shall be constructed of Grade 60 steel reinforcing rod (min. 1/2-inch) and completely encapsulated with a wear resistant and chemical resistant polypropylene plastic. Steps shall be provided in accordance with Owner's Standard Detail No. S-06 on Drawing 01-C-602.

B. Each step shall have a minimum vertical load resistance of 800 pounds and a minimum pull-out resistance of 400 pounds.

C. The steps shall have 12-inch minimum tread width and shall be placed at 16 inches on center as shown on the Drawings.

D. Steps shall be cast in place with the precast concrete section.

E. Steps shall only be installed as shown on the Drawings or required in the Specifications.

## 2.09 JOINT SEALANTS AND GASKETS

A. For precast utility structure joints required to conform to ASTM C990, joint sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C990, paragraph 6.2, Butyl Rubber Sealant. Joint sealant shall be Ram-Nek by Henry Company or equal.

B. For precast utility structure joints required to conform to ASTM C443, gaskets shall be rubber gaskets conforming to the requirements of ASTM C443.

## 2.10 PIPE TO MANHOLE CONNECTIONS

A. The spring set type shall have a stainless steel interior power sleeve or expander and shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal | 106-406 Series assembly by National Pollution Control Systems, or QUIK-LOK Boot Connector by A-LOK Products, Inc, or equal.

B. The cast-in-place type shall conform to ASTM C923 for sanitary sewer connections between reinforced concrete manhole structures, pipes, and laterals, ASTM C1478 for storm drain connections between pipes, and laterals, and ASTM F2510 for storm drain connections between reinforced concrete manhole structures, and dual and triple-wall polyethylene and polypropylene pipes. Sleeves shall include stainless steel take up clamps.

C. Flexible seal assemblies shall permit at least an 8 degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

## 2.11 COVERS AND FRAMES

A. Covers and frames shall comply with Section 05 56 00 – Castings and shall be provided by the utility structure manufacturer.

B. Manhole covers and frames shall meet the following requirements:

1. Locate so that there is ready access to the manhole steps

2. Clear opening shall be a minimum of 21.5 inches, unless otherwise indicated on the Drawings.

3. Watertight manhole frames and covers shall be suitable for 20 psi internal pressure, shall be by Neenah Foundry or equal, shall be cast in place, and shall be in accordance with Owner’s Standard Detail No. S-08 on Drawing 01-C-601.

4. Non-watertight (i.e., standard) manhole frames and covers shall be suitable for 20 psi internal pressure, shall be by Neenah Foundry or equal, shall be cast in place, and shall be in accordance with Owner's Standard Detail No. S-07 on Drawing 01-C-601.

5. Storm drain grated inlet frames and grates shall be Neenah R-1878-B7G, East Jordan Iron Works V-5660, or equal.

6. Curb inlet frames and grates shall be Neenah R-3067, East Jordan Iron Works EJ 7030, or equal, and shall include frame, grate, and hood.

C. Vault covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05 05 23 – Metal Fastening.

D. The Load Level capacity of fabricated metal access hatches as noted on the Contract Drawings shall be in conformance with the requirements of ASTM C1802.

E. Frames and covers shall be identical throughout the Contract.

## 2.12 GRATES

A. Grates shall comply with Section 05 56 00 – Castings.

## 2.13 CONCRETE BALLAST

A. Concrete ballast shall be Class B concrete in conformance with Section 03 30 00 – Cast-in-Place Concrete. Ballast shall be provided as necessary to ensure manhole resists flotation when empty and subjected to full height groundwater conditions.

## 2.14 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterEmaco ADH Series by Master Builders Solutions.

# PART 3 – EXECUTION

## 3.01 DESIGN CRITERIA

A. Minimum structural design loading for underground precast concrete manholes and utility structures shall be in accordance with the applicable document of ASTM C890 or ASTM C857 specified in Article 2.01, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for HS-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.

B. Walls of precast items shall be designed for a vertical surcharge resulting in a 100 psf horizontal load.

C. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.

## 3.02 FABRICATION AND CASTING

A. Fabrication and casting of precast manholes and utility structures shall conform to the applicable ASTM documents specified in Article 2.01.

B. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.

C. Utility structures built around existing pipe shall have a cast-in-place base slab.

## 3.03 HANDLING, TRANSPORTING, AND STORING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28-day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.

D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.

E. Precast concrete members shall not be used as storage areas for other materials or equipment.

F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

## 3.04 INSTALLATION

A. Installation of precast manholes and utility structures shall conform with the manufacturer's recommendations.

B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.

C. Joints between riser sections shall be sealed with joint sealant or gaskets as specified herein.

D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.

E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.

F. All units shall be installed plumb and level.

G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03 60 00 – Grout, grout inside and out.

H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.

I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.

J. Brick or Concrete Block

1. Brick or concrete blocks shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. The outside of walls shall be plastered with a minimum 1-inch-thick coat of cement-sand mortar troweled smooth.

K. Connection to Existing Pipe

1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.

2. Provide adequate protection to prevent damage to the existing pipe.

3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.

4. Cut off the existing pipe sufficiently for connection to the new structure and remove.

5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.

6. Install a flexible joint sealer around the pipe.

7. Grout inside and outside of wall penetration with non-shrink grout.

L. Backfill structures in accordance with Section 31 00 01 – Earthwork.

M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.

N. Excavation shall conform to Section 31 00 01 – Earthwork.

O. Structure bases shall bear on a minimum of 8 inches of compacted stone unless otherwise indicated on the Drawings.

P. Channel Inverts

1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth precast inverts are acceptable.

2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.

3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.

## 3.05 ADJUSTMENTS TO EXISTING UTILITY STRUCTURES

A. Adjust structures as indicated on the Drawings using brick, concrete, and/or cast-iron adjustment rings by approved methods. Adjustment of existing utility structures shall be in accordance with Owner's Standard Detail No. S-09 on Drawing 01-C-601.

B. Clean covers and inlet castings of all foreign material.

## 3.06 ADJUSTING COLLARS AND FINAL ADJUSTMENTS

A. Adjusting collars shall be as shown on the Drawings, or as necessary meet final grade. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.

## 3.07 LEAKAGE TESTING FOR MANHOLES

A. All manholes shall be vacuum tested as specified below. Refer to Section 33 24 00 – Storm Drains and Roof Drains for storm water pipe testing methods and requirements and Section 40 05 00 – Basic Mechanical Requirements for sanitary pipe testing methods and requirements.

B. Manhole vacuum testing shall include the following minimum requirements:

1. Testing shall be done in accordance with ASTM C1244.

2. Prior to testing all pipes, holes, and vents entering manhole shall be plugged and braced.

3. Contractor shall have an approved test head and copy of instructions for use by the manufacturer.

4. Contractor shall furnish two certified and calibrated vacuum test gauges for the test.

a. A vacuum of 10-inch hg shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time for the vacuum pressure to drop to 9-inch hg shall be measured. If the test time meets or exceeds the test time as specified in Table 1, the manhole is acceptable; otherwise, the test has failed and the manhole should be checked for leaks, repaired, and re-tested.

**Table 1**
**Minimum Vacuum Test Times (Seconds) for Various Manhole Diameters and Depths**

**Manholes Ø (inches)**

| Depth (ft) | 48 | 60 | 72 | 84 | 96 | 108 | 120 |
|---|---|---|---|---|---|---|---|
| 6’ | 15 | 20 | 25 | 29 | 34 | 38 | 43 |
| 8 | 20 | 26 | 33 | 38 | 45 | 51 | 57 |
| 10 | 25 | 33 | 41 | 48 | 56 | 63 | 71 |
| 12 | 30 | 39 | 49 | 57 | 67 | 76 | 85 |
| 14 | 35 | 46 | 57 | 67 | 78 | 89 | 100 |
| 16 | 40 | 52 | 67 | 76 | 89 | 101 | 114 |
| 18 | 45 | 59 | 73 | 86 | 100 | 114 | 128 |
| 20 | 50 | 65 | 81 | 95 | 111 | 126 | 142 |
| 22 | 55 | 72 | 89 | 105 | 122 | 139 | 156 |
| 24 | 59 | 78 | 97 | 114 | 133 | 152 | 170 |
| 26 | 64 | 85 | 105 | 124 | 144 | 164 | 185 |
| 28 | 69 | 91 | 113 | 133 | 155 | 177 | 199 |

| Depth (ft) | 48 | 60 | 72 | 84 | 96 | 108 | 120 |
|---|---|---|---|---|---|---|---|
| 30 | 74 | 98 | 121 | 143 | 166 | 189 | 213 |
| Add. VF | +2.5 | +3.25 | +4.0 | +4.75 | +5.5 | +6.5 | +7.0 |

## 3.08 FLUSHING AND TESTING OF SEWERS

A. After backfilling, all sewers shall be inspected for obstructions and shall be flushed with water. Flushing shall be a minimum velocity of 2.5 feet per second for a duration acceptable to the Engineer. Flushing shall remove all dirt, stones, pieces of wood and other debris which accumulated in the sewer during construction. The Contractor shall provide a means acceptable to the Engineer for removal of debris flushed from each section of sewer. If after flushing, any obstructions remain, they shall be removed at the Contractor's expense.

B. Visual Inspection: Sewer lines shall be visually inspected from every manhole by use of mirrors, television cameras, or other devices for visual inspection, and the lines shall all exhibit a fully circular pattern when viewed from one manhole to the next. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these qualifications. Any visual water infiltration of water into the manhole shall be repaired using hydraulic cement or other approved materials.

C. Leakage: Sewers shall be tested for leakage. The program of testing shall fit the conditions as mutually determined by the Engineer and the Contractor. The Contractor shall take all necessary precautions to prevent any joints from drawing while the sewers or their appurtenances are being tested. The Contractor shall, at the Contractor’s own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances, or to any structures resulting from or caused by these tests.

D. Leakage Test Procedure: Each section of sewer shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers and filling the pipe and manhole with water to a point 6 feet above the crown of the open sewer in the upper manhole, or, if ground water is present, 6 feet above the sections average adjacent ground water level as indicated by a monitor well installed adjacent to each manhole. The line shall be filled with water prior to testing and allowed to stand until the pipe has reached its maximum absorption, but not less than 2 hours. After maximum absorption has been reached, the head shall be reestablished and tested for at least 6 hours maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.

    1. If ground water is present to a height of at least 6 feet above the crown of the sewer at the upper end of the pipe section to be tested, the leakage test may be made by measuring the rate of infiltration using a suitable weir or other measuring device approved by the Engineer. Whether the test is made by infiltration or

exfiltration, the allowable leakage shall not exceed 100 gallons per day per inch of diameter per mile of sewer being tested.

2. Where the actual leakage exceeds the allowable, the Contractor shall discover the cause and correct it before the sewer will be accepted. A section of sewer is defined as that length of sewer between successive manholes or special structures or stub-outs for future connections.

E. Low Pressure Compressed Air Test: If the leakage cannot be located by infiltration or exfiltration testing, this type test may be used. The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater that may submerge the pipe if the section under test does not lose air at a rate greater than 0.0030 cfm per sq. ft. of internal pipe surface.

F. Deflection Test: No sooner than 30 days after final backfill installation, each section of PVC pipe shall be checked for vertical deflection using an electronic deflectometer or a rigid "GoNoGo" device. Vertical deflection shall not exceed 5 percent of the inside pipe diameter for PVC pipe.

1. Where the actual deflection exceeds the allowable, the Contractor shall discover the cause and correct before the pipe will be acceptable. A section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.

G. Cost of Testing and Repairs: Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Contractor at no extra cost to the Owner. All apparent sources of infiltration and excessive deflection shall be repaired by the Contractor.

1. The Contractor shall provide all water, plugs, hoses, pumps, equipment, etc. necessary for the proper flushing and testing of the sewers.

**END OF SECTION**

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## SECTION 33 24 00
## STORM DRAINS AND ROOF DRAINS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all labor, equipment, and materials in connection with the installation of exterior underground storm drains and roof drains as shown on the Contract Drawings and specified herein.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C150 – Standard Specification for Portland Cement

B. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

D. ASTM C1619 – Standard Specifications for Elastomeric Seals for Joining Concrete Structures

E. ASTM C1628 – Standard Specifications for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets

F. ASTM D1056 – Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber

G. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications

H. ASTM D3350 – Standard Specifications for Polyethylene Plastic Pipe and Fitting Material

I. ASTM F2603 – Standard Specifications for 300 mm to 1500 mm [12 in. to 60 in.] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Non-Pressure Gravity-Flow Storm Sewer and Subsurface Drainage Applications

J. AASHTO LRFD Bridge Construction Specification

01-17-20

K. AASHTO M 252 – Standard Specification for Corrugated Polyethylene Drainage Pipe

L. AASHTO M 294 – Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

M. AASHTO Section 30 – Thermoplastic Pipe

N. ACPA Post Installation Evaluation and Repair of Installed Reinforced Concrete Pipe, latest edition

### 1.04 SUBMITTALS

A. Furnish and submit shop drawings and certificates for the piping work as outlined in the General Conditions and Division 01 – General Requirements.

B. Special care shall be exercised during delivery, distribution and storage of the pipe and fittings to prevent damage. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

## PART 2 – PRODUCTS

### 2.01 REINFORCED CONCRETE PIPE – STORM DRAINS AND CULVERTS

A. Pipe and Joints

1. Reinforced concrete pipe (RCP) for storm drains and culverts shall conform to ASTM C76, Class III, Wall thickness B, unless otherwise noted on the Drawings. Elliptical reinforcement will not be permitted. All pipe shall be aged at the manufacturing plant for at least 14 days before delivery to the job site. All pipe shall be of the sizes indicated on the Drawings

2. Pipe joints shall be designed per ASTM C443 and ASTM C1628. Pipe shall be provided with bell and spigot ends.

B. Gaskets

1. Gaskets shall be leak-resistant with elastomeric seals (gaskets) made of natural rubber, synthetic rubber, or a blend of both meeting the physical requirements prescribed in ASTM C1619 for Class A, C, or E gaskets.

C. Joint Lubricant

1. Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum-based lubricants is not permitted.

## 2.02 DUCTILE IRON PIPE (DIP) AND PVC ROOF DRAINS (NOT USED)

## 2.03 SMOOTH LINED CORRUGATED HIGH-DENSITY POLYETHYLENE PIPE - STORM DRAINS AND CULVERTS

A. General

1. Smooth-lined, corrugated, high-density polyethylene (HDPE) pipe shall be used for storm drains and shall be BLUE SEAL watertight HDPE pipe as manufactured by Hancor, Inc., N-12 WT IB (Watertight) Pipe by ADS, Inc., or approved equal.

B. Pipe and Fittings

1. Smooth lined corrugated HDPE pipe and fittings shall conform to AASHTO M 252 - TYPE S for 4- to 10-inch diameter and AASHTO M 294 - TYPE S for 12- to 36-inch diameter. All pipes shall be of the sizes indicated on the drawings.

C. Joints

1. Joints shall be watertight bell and spigot type; Hancor, Inc. BLUE SEAL, ADS, Inc. N-12 WT IB, or equal.

D. Foundation Drains

1. Foundation drains shall conform to AASHTO M 252-TYPE C. Drains shall have drilled perforations and be Heavy Duty-AASHTO Pipe as manufactured by Hancor, Inc., Single Wall Corrugate Pipe by ADS, Inc., or approved equal.

E. Typical Trench

1. Trench for HDPE installation shall meet Type C typical trench detail.

## 2.04 BACKFILL MATERIAL

A. The material obtained from excavation of the pipe trench or elsewhere on site with a particle size not greater than 3 inches shall be used for pipe backfill if they conform with the soil classes given in Table 1. Imported materials meeting the criteria of Table 1 may also be used.

B. Class I and Class II are acceptable materials for HDPE pipe backfill. Class I must be compacted.

**Table 1: Acceptable Select Backfill Material and Compaction Requirements**

| Soil Classifications | | | | |
|---|---|---|---|---|
| **Description** | **ASTM D2321** | **ASTM D2487** | **AASHTO M 43** | **Minimum Standard Proctor Density %** |
| Graded or crushed, crushed stone, gravel | Class I | -- | 5<br>56 | Dumped* |
| Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines | Class II | GW<br>GP<br>SW<br>SP | 57<br>6 | 95% |
| Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures | Class III | GM<br>GC<br>SM<br>SC | Gravel and Sand (<10% fines) | 95% |

*Class I select backfill shall be compacted when used as HDPE pipe backfill

## PART 3 – EXECUTION

### 3.01 INSPECTION

A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Contractor shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

### 3.02 INSTALLATION

A. Trenching, bedding, and backfilling shall be as specified in Section 31 00 01 – Earthwork of these Specifications and Article 2.04 Backfill Material of this Section. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.

B. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes, or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.

C. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.

D. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.

E. Cutting of RCP shall be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.

F. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.

G. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required, and the foundation brought to desired grade with suitable granular material.

H. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.

I. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches before further backfill is placed.

J. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.

K. Inorganic silts, gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.

L. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

M. The HDPE storm drain pipe/culvert manufacturer/ supplier shall be required to have a qualified representative on site at the start of HDPE pipe installation. The Contractor shall submit work experience documentation for the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the HDPE storm drain pipe/culvert installation for the project.

## 3.03 COMPACTION

A. General

1. Place and ensure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.

2. In no case shall degree of compaction below “Minimum Compactions” specified be accepted.

B. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other Sections of these Specifications, comply with following trench compaction criteria:

**Table 2: Minimum Compactions**

| Location | Soil Type | Density |
|---|---|---|
| **Compacted Select Backfill** | | |
| All applicable areas | Cohesive soil | 95 percent of maximum dry density by ASTM D698 |
| | Cohesionless soils | 75 percent of maximum relative density by ASTM D4253 and ASTM D4254 |
| | Crushed stone | Compacted when used with HDPE pipe |
| **Common Trench Backfill** | | |
| Under pavements, roadways, surfaces, ASTM D698 within highway rights-of-way, adjacent to retaining walls | Cohesive soils | 95 percent of maximum dry density by ASTM D698 |
| | Cohesionless soils | 75 percent of maximum relative density by ASTM D4253 and ASTM D4254 |
| Under turfed, sodded, plant seeded, non-traffic areas | Cohesive soils | 95 percent of maximum dry density by ASTM D698 |
| | Cohesionless soils | 75 percent of maximum relative density by ASTM D4253 and ASTM D4254 |

C. Ensure backfill materials have moisture content within 3 percent of optimum moisture content at the time of placement.

## 3.04 INSPECTION AND TESTING

A. General

1. The Contractor shall provide at his own expense, all labor, material, video and measuring devices, water, plugs, or other equipment necessary to perform the required tests. All tests shall be performed in the presence of the Engineer and evaluated in accordance with the AASHTO LRFD Bridge Construction Specification Sections 27.6.4 & 5 and ACPA Post Installation Evaluation and Repair of Installed Reinforced Concrete Pipe. Disposal of water shall be in accordance with Section 01 11 00 – Summary of Work.

B. Tests by Manufacturer

1. HDPE: An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration

allowance shall not exceed 250 gallons per inch of pipe diameter per mile per day. One joint test for each 200 feet of pipe to be furnished.

C. Field Test - Visual Inspection of installed RCP

1. Examine structures and pipes for:

a. Physical damage.

1) Crack less than or equal to 0.01”: Acceptable

2) Crack between 0.01” and 0.10”: Evaluation is required; is crack detrimental and in a corrosive environment (pH<5.5)?

a) If non-corrosive or not detrimental: Acceptable

b) If corrosive and detrimental: Seal crack

3) Crack equal to or greater than 0.10”: Evaluation is required

a) If not detrimental: Acceptable

b) If detrimental: Repair and seal crack

c) If not repairable: Remediate or replace

b. Indication of displacement of pipes or structures, reinforcement, forms, or bedding.

c. Deflection and joint separation shall be within the tolerances as specified by AASHTO or the manufacturer, whichever is more restrictive.

e. Slabbing or spalling. Porous areas or voids.

f. Proper placement of seals, gaskets, and embedments.

g. Visible infiltration.

2. Verify structures and pipes are set to proper line and grade as per the Contract Drawings and are plumb.

3. Verify structure and pipe dimensions and thickness match Contract Drawings.

4. Measure inside dimensions of all flexible (HDPE) pipe prior to installation. Use these dimensions when sizing the mandrel should deflection testing be required.

a. Using light to inspect pipe shall be done following pipe trench backfill is compacted and brought to grade or pavement subgrade.

b. Full pipe diameter shall be visible for entire length of each section between structures.

c. No less than half pipe diameter shall be visible for horizontal alignment.

5. The Contractor shall be responsible for providing video recording of the all installed storm sewer systems at least 30 days after completion of backfill and 1 month before Owner or Engineer gives final acceptance for the 1-year warranty. The recording shall be made using a color camera, self-propelled or other, having sufficient light to show detail of problem areas and joints. Camera speed shall not exceed 3 feet per second. If problems or concerns are seen by the operator, then the camera shall be reversed and an extended look at the area will be recorded. All recordings will have time, date, and footage displayed. Supplement the video recording with a written log or orally recorded tape log noting observations, findings, and deficiencies shown on the video tape.

   a. The video recording inspection shall be performed by an outside independent testing agency acceptable to the Owner or Engineer.

   b. The video tape and log will be given to the Engineer for review. If the Engineer finds any problems with the storm sewer, the Contractor shall repair the problem and re-camera the repaired area before final acceptance will be given, at no added cost to the Owner.

   c. Video recording of storm sewer may be waived if pipe diameter is sufficient for human access, as determined by the Engineer. A log shall be developed for such inspection.

   d. One copy of the video tape and log will become permanent property of the Engineer and Owner as record.

D. Field Test – Manhole Testing

1. The finished manholes shall be as watertight as the pipe system of which it is part. See Section 33 05 61 – Utility Structures for manhole testing criteria.

2. Observed leaks (infiltration or exfiltration) at any time within the warranty period shall be cause for rejection.

E. Deflection Test – Flexible Pipe

1. If after the visual or video inspection of the storm trunk or lateral lines, the Inspector finds there is “egging or deflection” of a section of pipe, a deflection test shall be performed on the defective section of pipe installed. Test shall be performed using an odd-legged mandrel pulled through the pipe without mechanical assistance or by laser profiling. The mandrel size shall be the

measured inside diameter of the subject pipe minus 5% of the measured diameter. The mandrel shall have no less than nine legs.

2. Any pipe failing any deflection test shall be removed, replaced, and retested.

3. At the end of the 1-year warranty period, the flexible storm pipe will be visually inspected for “egging or deflection”. If excess deflection is observed, the Owner will, at his/her expense, retest questionable portions per this Section.

F. Repair

1. Repair or replace any damaged pipe or work found unacceptable by the Engineer at no additional cost to the Owner. Repairs to RCP shall be made according to the requirements of AASHTO, ASTM C990 (14.1), and ACPA Post Installation Evaluation and Repair of Installed Reinforced Concrete Pipe.

2. Repair all visible leaks.

3. Remove any concrete webs or protrusions.

4. Remove form ties and repair tie holes.

**END OF SECTION**

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# SECTION 33 71 19
# UNDERGROUND ELECTRICAL

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install underground duct systems, electric manholes, and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.

B. The provisions of this Section are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.

C. Reference the following Specification Sections:

1. Section 03 21 00 – Reinforcing Steel

2. Section 03 30 00 – Cast-In-Place Concrete

3. Section 26 05 00 – Basic Electrical Requirements

4. Section 26 05 26 – Grounding and Bonding for Electrical Systems

5. Section 26 05 33.13 – Conduit for Electrical Systems

6. Applicable Sections of Division 31 – Earthwork

7. Section 33 05 61 – Utility Structures

### 1.02 CODES AND STANDARDS

A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:

1. AASHTO H20

2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

### 1.03 SUBMITTALS

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A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the

equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

## 1.04 SHOP DRAWINGS

A. Shop drawings shall include but not be limited to, the following:

1. Product data sheets

2. Outline and dimensional drawings including detailed sections of the manholes and/or handholes

3. Materials specifications and structural calculations for the manholes sealed by a Professional Engineer licensed in the state of Georgia

## 1.05 IDENTIFICATION

A. Each electric manhole and handhole cover shall be lettered with the word “Electric”, the manhole or handhole identification number (e.g., EMH-2601, EHH-2701), manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

## 2.02 DUCT SYSTEM

A. The underground duct system shall be comprised of conduits, conduit bends, and conduit fittings as specified in Section 26 05 33.13 – Conduit for Electrical Systems. Conduits shall be encased in reinforced concrete envelopes, unless otherwise specified herein or indicated on the Drawings.

B. Base and intermediate conduit spacers shall be furnished to provide a minimum of 2-inch separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4-inch conduit spacer shall not be used to secure a 2-inch conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or Engineer-approved equal.

## 2.03 ELECTRIC MANHOLES

A. The concrete manholes shall be complete with metal frames and covers of size and location as specified herein and shown on the Drawings.

B. Manhole frames and covers shall be Neenah R-1640C1, or equal, with Type A anchor ring. Entire manhole assembly shall be AASHTO H20 heavy duty rated. Precast manholes shall be constructed in accordance with the applicable requirements of Section 33 05 61 – Utility Structures. Covers shall be furnished with drop handles.

C. All medium voltage cables installed in the manholes shall be arc proofed and fireproofed.

D. All electric manholes shall be provided with non-metallic cable racks. Cable racks shall be rated for the application, with a minimum loading capacity of 450 lbs. per rack arm. Cable rack system shall be Heavy Duty type as manufactured by Underground Devices, Incorporated or Engineer approved equal.

## 2.04 ELECTRIC HANDHOLES

A. The electric handholes shall be a precast polymer concrete enclosure suitable for use as part of an underground electric raceway system. The enclosure shall meet or exceed the requirements of ANSI/SCTE 77-2010.

B. The enclosure and cover design and test load rating shall be Tier 15. Covers shall be provided with cover hooks.

C. The enclosure shall be the straight side design to allow easy adjustment of box to grade. The box shall be stackable for increased depth.

D. Handhole opening size shall be as required to suit the application, 6-inch x 8-inch, minimum.

E. The electric handholes shall be manufactured by Hubbell, Pencell Plastics equivalent, Highline Products equivalent, or Engineer approved equal.

# PART 3 – EXECUTION

## 3.01 GENERAL

A. The underground duct system, manholes, and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers' instructions.

## 3.02 DUCT SYSTEM

A. All underground conduits shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the Standard Details. Concrete shall be furnished and installed in accordance with Section 03 30 00 – Cast-In-Place

Concrete. Reinforcing steel shall be furnished and installed in accordance with Section 03 21 00 – Reinforcing Steel.

B. Concrete pours shall be complete from handhole to handhole and from manhole to manhole where practicable. Partial pours in general shall not be permitted. Where a complete pour is impractical, written authorization shall be obtained from the Engineer for the partial pour.

C. Conduit ductbank elevations at the manholes and handholes shall be based on minimum ductbank cover as indicated in the Standard Details, or deeper to avoid conflicts with other obstacles. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.

D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3 inches per 100 feet unless otherwise indicated on the Drawings.

E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the Standard Details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.

F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.

G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.

H. The ends of the bare copper cables embedded in the concrete ductbank shall be connected to structure and/or building ground rings where the ductbanks terminate, and to each other in manholes and handholes as specified herein.

I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer’s instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.

J. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.

K. Construct concrete-encased conduits connecting to underground structures to have a flared section adjacent to the manhole to provide shear strength. Construct underground structures to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.

L. At 6 inches above all duct banks, the Contractor shall furnish and install a 2-inch wide red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters: “ELECTRIC LINE BURIED BELOW.” Tape shall be Detectable Identoline by Brady or Engineer approved equal.

M. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading, and restoration of surfaces and seeded areas disturbed during the execution of the Work.

N. All conduit joints in the duct system shall be staggered such that adjacent conduits do not have joints in the same location.

## 3.03 ELECTRIC MANHOLES

A. Electric manholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 14 inches from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to the roof. All manholes shall be built on or placed over a 6-inch layer of well-tamped gravel.

B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.

C. All concrete work and fully assembled manholes shall be completely watertight and shall be furnished with sloped floors that pitch towards a sump pit. The outside surfaces shall be coated with an approved asphaltic waterproofing compound (all sides, bottom, and roof). Precast concrete manholes may be installed; however, all requirements of this Section and other Divisions of the Specifications and the details shown on the Drawings shall apply.

D. Install pulling eye irons imbedded in walls opposite each duct entrance securely fastened to manhole reinforcing rods. All hardware shall be hot-dipped galvanized steel.

E. A ground rod and a ground bar, furnished in accordance with Section 26 05 26 – Grounding and Bonding for Electrical Systems, shall installed at each manhole. Ground rod shall be driven within each manhole. The ground bar shall be installed inside each manhole. A No. 4/0 AWG bare copper ground cable shall be connected between the ground rod and the ground bar. The bare copper ground cable located within each duct bank shall also be connected to the ground bar. No. 6 AWG bare copper cables shall be connected from all non-current carrying metal parts in the manhole to the ground bar. All

cable connections at the ground bar shall be NEMA two-hole style lugs with irreversible compression style barrel made of copper or aluminum. Aluminum lugs shall be marked with an AL/CU rating for use on copper conductors.

F. All cables shall be well supported by non-metallic cable racks. The cable racks shall be heavy-duty type for medium- and low-voltage power cables and light -duty type for control, signal, communications, and similar small conductors. All racks shall be rigidly attached to the wall and equipped with adjustable rack arms.

## 3.04 ELECTRIC HANDHOLES

A. Electric handholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 9 inches from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to roof. All handholes shall be installed in accordance with Standard Detail E-33-0103.

B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.

C. All individual cables and/or bundles of conductors shall be identified and “dressed” along the wall of the enclosure. Cable racks as specified herein shall be provided if any handhole dimension exceeds 24 inches.

## 3.05 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Field tests

    a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.

    b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

**END OF SECTION**

## SECTION 40 05 00
## BASIC MECHANICAL REQUIREMENTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. Piping to be backfilled and/or encased in concrete is considered to be buried piping. Piping that is not buried is considered to be exposed.

B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.

C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.

D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.

E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.

F. The work shall include, but not be limited to, the following:

1. Connections to existing pipelines.

2. Test excavations necessary to locate or verify existing pipe and appurtenances.

3. Installation of all new pipe and materials required for a complete installation.

4. Cleaning, testing and disinfecting as required.

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G. Elastomers found in the piping and valves of conveyance systems carrying chloramines-treated water that contact the water shall be made of peroxide-cured EPDM. This requirement supersedes any specified elastomer in the individual Specification Sections for pipe and valves exposed to the product for this conveyance application.

## 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Division 02 – Existing Conditions

C. Division 05 – Metals

D. Division 09 – Finishes

E. Division 26 – Electrical

F. Division 46 – Water and Wastewater Equipment

## 1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

A. The Contractor shall furnish to the Owner (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, ANSI, etc.) for fabrication and testing.

B. Shop Drawings for major piping (2 inches in diameter and greater) shall be prepared and submitted in accordance with Section 01 33 00 – Submittal Procedures. In addition to the requirements of Section 01 33 00 – Submittal Procedures, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.

C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the

Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Part 3.

C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

D. All buried piping shall have restrained joints for thrust protection unless otherwise specified or shown on the Drawings. All exposed piping shall have flanged joints, unless otherwise specified or shown on the Drawings.

E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

## 2.02 WALL PIPES

A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange. The Contractor shall submit sizing calculations for the wall pipes to ensure the design provides a complete seal. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the following minimum dimensions:

| Pipe Size (inches) | Waterstop Flange Minimum Diameter (inches) | Waterstop Flange Minimum Thickness (inches) |
|---|---|---|
| 4 | 6.80 | 0.25 |
| 6 | 8.90 | 0.25 |
| 8 | 11.05 | 0.25 |
| 10 | 13.10 | 0.25 |
| 12 | 15.20 | 0.25 |
| 14 | 17.30 | 0.25 |
| 16 | 19.40 | 0.25 |

| Pipe Size (inches) | Waterstop Flange Minimum Diameter (inches) | Waterstop Flange Minimum Thickness (inches) |
|---|---|---|
| 18 | 22.50 | 0.38 |
| 20 | 24.60 | 0.38 |
| 24 | 28.80 | 0.38 |
| 30 | 36.00 | 0.38 |
| 36 | 42.30 | 0.38 |
| 42 | 50.50 | 0.50 |
| 48 | 57.05 | 0.50 |
| 54 | 64.25 | 0.50 |
| 60 | 69.75 | 0.50 |
| 64 | 73.75 | 0.50 |

## 2.03 SLEEVES

A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.

B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09 90 00 – Painting.

C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 316 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided

consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and 316 stainless steel bolts and nuts.

D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to affect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

## 2.04 SOLID SLEEVE COUPLINGS (FOR BURIED SERVICE)

A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal. Solid sleeve couplings shall be restrained with wedge-type restraining glands to meet the pressures specified in 40 06 20 – Schedules.

B. Alternatively, EBAA Iron 3800 Mega-Coupling is acceptable.

## 2.05 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters shall be furnished as required and as shown on the Drawings.

B. Flanged coupling adapters shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.

C. All flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs unless otherwise approved by the Engineer.

D. Flanged coupling adapters shall be manufactured by Smith-Blair Model 912 or 913, Romac Industries Model FCG or FC 400, Dresser Industries Model 128-W, or equal.

E. Flanged coupling adapters shall be provided with manufacturer’s fusion bonded epoxy painting system.

## 2.06 DISMANTLING JOINTS

A. Dismantling joints shall be furnished at locations shown on the Drawings.

B. Dismantling joints for sizes less than 12 inches shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.

Dismantling joints for sizes greater than 12 inches shall be of carbon steel construction and shall have a minimum working pressure rating equal to or exceeding the specified test pressure of the connected pipe.

C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.

D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer's recommendations.

E. Dismantling joints shall be provided with manufacturer's fusion bonded epoxy painting system.

F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

## 2.07 GROOVED COUPLINGS

A. Grooved end pipe couplings shall be furnished as specified or shown on the Drawings.

B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.

C. Gaskets shall be rubber. Bolts and nuts shall be heat-treated carbon steel track bolts and shall be plated.

D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09 90 00 – Painting.

E. Couplings shall be manufactured by Victaulic Company of America Style 31 or equal.

## 2.08 TAPPING SLEEVES AND TAPPING SADDLES

A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than 12 inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.

B. Tapping saddles may be used on mains 16 inches and larger where the required tap size does not exceed one-half the size of the main (i.e., 8-inch tapping saddle for use on a 16-inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110-77 flange connection on the branch. Sealing gaskets shall be

"O" ring type, high quality molded rubber having an approximate 70 durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

## 2.09 UNIONS

A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.

B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.

C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

## 2.10 HEAT TRACED PIPING (NOT USED)

## 2.11 FLEXIBLE RESTRAINED EXPANSION JOINTS

A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.

B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.

C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.

D. All bolts used in the assemblies shall be stainless steel.

E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.

F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.

G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1. Each assembly shall be tested at 350 psi before shipment.

H. Restrained expansion joints shall provide for self-restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.

I. Flexible restrained expansion joints shall allow for 8 inches (+6 inches, -2 inches) minimum expansion.

J. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15-degree deflection per ball.

K. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

## 2.12 RESTRAINT HARNESSES (FOR BURIED C900 PVC SERVICE THROUGH 12-INCH)

A. Split serrated restraint harnesses shall be used to connect buried C900 PVC piping at each bell and spigot joint. Split serrated restraint harnesses shall conform to ASTM A536 and shall be EBAA Iron Series 1900 or equal.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practices for piping installation and as recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.

C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.

D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.

E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.

F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.

G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately 100 feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.

H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.

I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURER’S RECOMMENDED DEFLECTION.

J. Excavation and backfilling shall conform to the requirements of Section 31 00 01 – Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.

K. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.

L. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

M. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to 1 foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

N. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.

O. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.

P. AT THE CLOSE OF EACH WORK DAY, THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.

Q. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.

R. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.

S. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation

and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.

T. ALL PIPING SHALL HAVE TYPE "A" BEDDING AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.

U. Detector tape shall be installed 12 inches below final grade and directly above all buried potable water piping. The tape shall be blue and silver and shall be clearly and permanently labeled "Water". Detector tape shall be Lineguard III as manufactured by Lineguard, Inc., or equal.

V. At the close of work each day, pipeline trenches shall be completely backfilled. In paved areas, the surface shall be restored as specified in Section 32 10 00 – Paving and Surfacing to allow for traffic over the trench during non-working hours. Under no conditions shall any pipeline trench be left open during non-working hours.

**3.02 CARBON AND STAINLESS STEEL PIPE**

A. Installation of steel pipe shall be by skilled workmen and shall conform to the applicable sections of AWWA M11 – Steel Pipe–A Guide for Design and Installation. Joints for steel piping shall be either screwed, welded, or flanged as shown on the Drawings or as specified.

B. Welding in the field shall be performed only when requested on the shop drawings and permitted by the Engineer for carbon steel pipe. No welding of stainless steel pipe shall be allowed in the field. All field welds shall be radiographically inspected.

C. Installation of the steel casing pipe shall be by skilled workmen and in accordance with the best standard practice for steel pipe installation. Joints for steel casing pipe shall be butt welded.

1. The boring equipment to be used for installing the jacked casing shall be of such size and capacity to allow the boring to proceed in a safe and expeditious manner. The installation of the casing and boring of the hole shall be done simultaneously to avoid cave-ins or settlement and for safety of traffic above.

2. The Contractor shall check the vertical and horizontal alignment of the casing by survey instrument at least once during each four feet of advance, or as directed by the Engineer. Pits shall be well sheeted and braced as necessary for safe and adequate access for workmen, inspectors and materials and shall be of a size suitable to equipment and material handling requirements.

3. Under no conditions shall jetting or wet boring of encasement under pavement be allowed.

4. After installation of the carrier pipe, each end of the casing pipe shall be made watertight with a brick masonry bulkhead. In addition, a Class B concrete cradle shall be provided from each end of the bulkhead to the first pipe joint outside of the bulkhead.

**3.03 JOINTS IN PIPING**

A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.

B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed, and the condition corrected.

C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.

D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.

E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be

processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.

F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to ensure equal distribution of flux. Joints shall be heated and solder applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self-cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.

G. Welded joints shall be made by competent operators in a first-class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.

H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.

I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.

J. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

| | Zinc | Galvanized Steel | Aluminum | Cast Iron | Ductile Iron | Mild Steel/ Carbon Steel | Copper | Brass | Stainless Steel |
|---|---|---|---|---|---|---|---|---|---|
| **Zinc** | | | ● | ● | ● | ● | ● | ● | ● |
| **Galvanized Steel** | | | ● | ● | ● | ● | ● | ● | ● |
| **Aluminum** | ● | ● | | ● | ● | ● | ● | ● | ● |
| **Cast Iron** | ● | ● | ● | | | | ● | ● | ● |
| **Ductile Iron** | ● | ● | ● | | | | ● | ● | ● |
| **Mild Steel/ Carbon Steel** | ● | ● | ● | | | | ● | ● | ● |
| **Copper** | ● | ● | ● | ● | ● | ● | | | ● |
| **Brass** | ● | ● | ● | ● | ● | ● | | | ● |
| **Stainless Steel** | ● | ● | ● | ● | ● | ● | ● | ● | |

Notes:
● signifies dielectric isolation is required between the two materials noted.
Consult Engineer for items not listed in table.
Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment.
Contractor shall include all isolation descriptions with piping submittals.

K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

L. Joints in polypropylene and polyvinylidelene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D2657 and the manufacturer's recommendations.

## 3.04 FLUSHING AND TESTING

A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Gravity sewer piping shall be flushed and tested as specified in Section 33 05 61 – Utility Structures. Polymer piping shall be tested with mineral oil or as recommended by the polymer chemical supplier. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish

and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 40 06 20 – Process Pipe, Valve and Gate Schedules and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. Do not test exterior exposed pipelines if air temperature is expected to fall below 32 degrees F. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.

C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.

D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 5.0 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.

E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one compressor, in accordance with the manufacturer's instructions.

F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.

G. All process air piping shall be leak tested by applying a soap solution to each joint. Leak tests shall be conducted with one blower in service at normal operating pressure.

H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

I. All buried process air piping shall be pressurized to 25 psig and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the 25 psig test pressure over a one hour test period. Should the system fail to hold the required pressure for one hour, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.

J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear non-potable water for visual identification of all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.

K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.

L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

M. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

**3.05 DISINFECTION OF PIPELINES**

A. Following acceptable pressure testing, flush and disinfect all sections of the water distribution system and receive approval thereof from the appropriate agencies, prior to placing in service. Do not disinfect exterior exposed pipelines if air temperature is expected to fall below 32 degrees F. Advance notice of 24 hours shall be provided to the Owner and Engineer before disinfecting procedures start. The flushing and disinfection shall be accomplished in accordance with the applicable provisions of AWWA C651 - Disinfecting Water Mains and all appropriate approval agencies.

B. Administration shall be by any of the several methods described in AWWA C651 and as proposed by the Contractor and approved by the Owner and Engineer. Contractor shall submit a proposal describing the desired disinfection method, which shall be approved by the Owner and Engineer prior to commencement of the disinfection process.

C. The initial chlorine dose shall be as described in AWWA C651 for the selected disinfection method. Chlorinated water must be retained in the pipeline long enough to destroy all non-spore forming bacteria, and not less than the retention time

recommended for the selected disinfection method per AWWA C651. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at other representative locations shall be as described in AWWA C651 for the selected disinfection method.

D. During the period that the chlorine solution or slug is in the section of pipeline, valves shall be opened and closed to obtain a chlorine residual at hydrants and other pipeline appurtenances. Care shall be taken to ensure that no chlorinated water enters any active pipeline.

E. Following contact with chlorine solution, the system shall be thoroughly flushed out per Section 4.9 of AWWA C651. All highly chlorinated water shall be flushed out within 72 hours of filling the main with highly chlorinated water. Samples shall then be taken using sterile containers obtained from the local regulatory agency. Samples shall be taken by the Contractor and delivered to the local regulatory agency or approved laboratory for analysis at the Contractor's expense.

F. If samples test positive for coliform organisms, the disinfection procedure shall be repeated until two series of satisfactory samples are obtained, the period between such series of samples to be a minimum of 24 hours. Contractor shall be responsible for all costs associated with repeat tests. The Contractor shall obtain certificates of satisfactory bacteriological tests and furnish them to the Owner before the request is made for acceptance of the work. Bacteriological testing shall conform to Section 5 of AWWA C651.

G. Chlorine residual tests will be performed after flushing to assure that residual is no higher than what is acceptable to the Owner based on the normal prevailing residual in the drinking water distribution system. Testing shall be performed at multiple locations throughout the piping system to verify residual values.

H. Following disinfection, pipelines and appurtenances shall remain isolated from any operational water system facilities until evidence has been submitted to Owner demonstrating that the pipelines and appurtenances have been adequately and properly disinfected. Normally, pipelines and appurtenances shall be isolated for at least 48 hours, unless a longer period is dictated by the Owner.

I. Sanitary construction methods must be followed during installation of the final connections so no contamination of the new or existing water main with foreign material or groundwater occurs. Materials used for final connections shall be disinfected in accordance with Section 4.10 of AWWA C651.

J. All water used in testing and disinfecting the portions of pipeline, including that used for retesting, shall be disposed of following such testing, retesting, and disinfecting, by the Contractor at its own expense. If required by any agency having jurisdiction, the Contractor shall apply a reducing agent to the solution to neutralize residual chlorine or chloramines remaining in the water. The disposal of water shall, in all cases, be carried

out in strict observance of the water pollution control requirements of the local and state regulatory agencies. The flow of water from the portions of the pipeline shall be controlled to prevent erosion of surrounding soil, damage to vegetation, and altering of ecological conditions in the area.

## 3.06 PAINTING AND COLOR-CODING SYSTEM

A. All exposed piping specified shall be labeled in accordance with Section 40 05 97 – Piping and Equipment Identification Systems. In the absence of a standard designation, the Engineer will establish a standard designation.

B. All piping specified in this Section shall be painted in accordance with Section 09 90 00 – Painting, except as follows:

1. Copper pipe

2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

**END OF SECTION**

# SECTION 40 05 07
# PIPE SUPPORTS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 73 23 – Anchorage and Bracing of Non-Structural Components

B. Division 03 – Concrete

C. Section 05 05 13 – Galvanizing

D. Section 05 05 23 – Metal Fastening

E. Section 05 10 00 – Metal Materials

F. Section 05 12 00 – Structural Steel

G. Section 05 13 00 – Stainless Steel

H. Section 05 50 00 – Metal Fabrications

I. Section 40 05 00 – Basic Mechanical Requirements

### 1.03 SUBMITTALS

A. Pipe support submittals will not be reviewed prior to review and acceptance of pipe layout submittal. Pipe support submittal shall be fully coordinated with approved pipe layout submittal. Contractor shall use approved piping layout submittal drawings to show proposed pipe support type and location with accurate dimensions to demonstrate that supports meet all specified requirements.

B. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01 33 00 – Submittals, Section 40 05 00 – Basic Mechanical Requirements and other previously referenced Sections herein.

1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type supports.

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2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.

3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer, licensed in the State or Commonwealth in which the project is located, showing that the piping support system complies with the specified requirements, including all building code and seismic code requirements pertaining to support of piping and other non-structural components. See Section 01 73 23 – Anchorage and Bracing of Non-Structural Components.

4. Table showing the manufacturer's recommended hanger support spacing for PVC, CPVC and FRP pipe for the services listed in Section 40 06 20 – Process Pipe, Valve and Gate Schedules.

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. The Contractor shall be responsible for the design of all piping support systems unless noted otherwise herein. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a pipe support design sealed by a Professional Engineer, licensed in the State or Commonwealth in which the project is located. Standard details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor designed pipe supports that will be acceptable.

B. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.

C. Where special pipe support fabrications are required, products and execution shall be as specified in Section 05 50 00 – Metal Fabrications and other related and referenced Sections of the Specifications.

D. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if they are strengthened to support the additional load.

E. Contractor's pipe support design should include, but not be limited to, the following criteria and loads imposed on the piping system:

1. Thrust Loads based on the design pressures as specified in Piping Schedules in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.

2. Dead loads and live loads per the latest version of ASCE/SEI 7 or the local building code if more stringent. Loads shall include, but not be limited to, the following:

    a. Weight of pipe

    b. Weight of pipe contents

    c. Weight of insulation

    d. Ice loads (If applicable by location, ice loads per code shall be applied as indicated in the governing building code)

    e. Seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Section 01 73 23 – Anchorage and Bracing of Non-Structural Components and the structural code drawing for project specific seismic design criteria. Seismic and sway bracing shall be provided at maximum 10-foot centers.

    f. Wind loads

3. Loads associated with thermal expansion and contraction of the piping system over the full range of potential temperatures the piping system could experience that should include, but not be limited to, the following:

    a. Ambient temperature range per local historical weather data (historic high and low obtained from NOAA)

    b. Process operating temperature range

    c. Exposure to sunlight where applicable

4. Additional pipe support design considerations shall include the following:

    a. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.

    b. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.

    c. The design, sizing and spacing of anchor bolts, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each particular support. The minimum anchor bolt size shall be ½ inches in diameter. Refer to Section 05 05 23 – Metal Fastening.

## 2.02 HANGERS AND SUPPORTS

A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from earthquake and/or wind (if outdoors). Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.

1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 304L stainless steel meeting the requirements of Section 05 13 00 – Stainless Steel.

2. Metal pipe support materials, where carbon steel, ductile or other ferrous pipe is supported, shall be galvanized carbon steel meeting Section 05 12 00 – Structural Steel and Section 05 05 13 – Galvanizing unless indicated otherwise on the Drawings or in the Specifications or by the Engineer.

3. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, earthquake, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hangar and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

B. Hangers and supports shall conform to the following requirements:

1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.

2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.

3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.

4. Supports and hangers for plastic and FRP piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.

5. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless steel hangers.

6. Ferrous pipes to be painted shall be painted in accordance with Section 09 90 00 – Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).

7. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.

8. Plastic piping shall be supported by plastic coated steel hangers and supports.

9. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.

10. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 316 stainless steel.

C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.

D. Non-metallic support system shall be a heavy-duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacings in the conformance with the pipe and support system manufacturer's requirements.

## 2.03 PROCESS AIR PIPE SUPPORTS

A. Unless specifically designed and detailed on the Drawings, process air piping shall be supported by slide bearings as manufactured by Fluorocarbon Company, Anaheim, California, Anvil International, Inc., Portsmouth, New Hampshire, or equal.

B. The slide bearing material shall be 3/32-inch-thick, 25 percent glass-fiber reinforced structural grade Teflon. The bearing material shall withstand at least 1000 psi (compression) at 250°F with a coefficient of friction between 0.05 and 0.08. The performance of bearing and bonding materials shall be unaffected by continual immersion in wastewater containing domestic and industrial waste at a temperature of 210°F.

C. Non-submerged slide bearing type supports shall be provided with a bearing material covering a 120° arc centered at the bottom of the pipe. The Teflon shall be at least 4 inches wide at the underside of the pipe and 8 inches wide at the top of the support. The Teflon material shall be hot press bonded to 10 ga. stainless steel plates for welding to the bottom of the pipe and securing to the top of the support.

D. Submerged slide bearing type supports shall be provided with Teflon bonded to the underside of the hold down strap and the top of the pipe such that the sliding surface is formed between two sheets of Teflon. Each surface shall cover a 120° arc centered at the top of the pipe. On the underside of the strap the Teflon bearing shall be hot press bonded directly to the stainless steel strap or to a 10-ga. stainless steel plate for welding to the strap. At the top of the pipe, the Teflon shall be bonded to a 1- ga. stainless steel plate for welding to the pipe.

E. Pipe straps shall not tightly bind the pipe, but shall provide 1/16-inch clearance over the top 180° of the pipe surface.

F. Wall bracket supports shall be used where shown for pipe to be installed adjacent to a wall. Where it is not feasible to install hanger supports, adjustable pipe saddle supports may be used with the permission of the Engineer. Concrete pier supports shall be spaced at a maximum distance of 10 feet and shall be at least 12 inches wider than O.D. of pipe and 10 inches thick unless otherwise shown on the Drawings. Refer to the Standard Detail Drawings.

G. Small diameter piping (6 inches in diameter or less) shall not be strapped or otherwise secured directly to walls. Suitable wall offset brackets of an approved type shall be used. Anchors shall not be attached using percussion fasteners.

H. Sliding surfaces shall be protected from accumulation of dirt, grit, or other foreign matter.

I. Slide bearings shall be capable of adequately supporting the design loads and shall be attached to pipe and supports as specified and recommended by the manufacturer.

J. The slide bearings shall be installed in the locations shown or indicated on the Drawings, at required elevations, true to orientation and level, assuring that the correct half of each bearing is in its proper position. The Contractor shall store the bearings to protect them from mechanical damage prior to installation and shall protect the same during and after installation from contamination and damage due to placing of concrete and other materials. The Contractor shall clean the operating surfaces of bearings thoroughly before final assembly.

K. The Contractor shall note that all pipe support locations are not shown on the Drawings and shall follow the Specifications herein in locating supports. Where deviations and modifications are required, they shall be made only with the permission of the Engineer. A detailed layout of pipe supports and hangers shall be submitted for approval.

## PART 3 – EXECUTION

### 3.01 GENERAL INSTALLATION REQUIREMENTS

A. Support piping connections to equipment by pipe support and not by the equipment.

B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.

C. Support no pipe from the pipe above it.

D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.

E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.

F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports and hydraulic thrust protection are submitted.

**END OF SECTION**

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## SECTION 40 05 19
## DUCTILE IRON PIPE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 09 90 00 – Painting

B. Reference Section 40 05 00 – Basic Mechanical Requirements

C. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, for pressure rating requirements for specific applications

### 1.02 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall submit a certificate from the Manufacturer stating that all linings have been provided in accordance with the specification requirements herein.

### PART 2 – PRODUCT

### 2.01 DUCTILE IRON PIPE AND FITTINGS

A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".

B. Ductile iron pipe of the sizes shown or specified shall conform to AWWA C151/A21.51, Grade 60-42-10 for ductile iron pipe centrifugally cast in metal molds or sand-lined molds.

C. Ductile iron pipe shall conform to AWWA C150/A21.50 for thickness design and shall be supplied in 18-foot or 20-foot nominal lengths or as required to meet the requirements of the Drawings.

D. Fittings and specials shall be cast iron or ductile iron and conform to the requirements of AWWA C110/A21.10 and AWWA C153/A21.53.

E. Minimum Class 53 pipe shall be used for flanged spools.

04-03-2023

## 2.02 PIPE COATINGS

A. All buried ductile iron pipe and fittings shall have a bituminous coating of standard thickness on the exterior surfaces in accordance with AWWA C151/A21.51.

B. All exposed ductile iron pipe and fittings shall have a shop-applied prime coat in accordance with Section 09 90 00 – Painting.

## 2.03 PIPE LININGS

A. All pipe and fittings, with the exception of epoxy- and glass-lined pipe and sleeves, shall be cement mortar-lined. Cement mortar linings shall conform to AWWA C104/A21.4 and shall be standard thickness. The mortar lining shall be protected with a bituminous seal coat.

B. Epoxy-Lined Pipe

1. Epoxy-lined ductile iron pipe shall be furnished and installed where specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

2. Epoxy linings shall be Induron Protecto 401 ceramic epoxy lining, Tnemec Perma-Shield PL Series 431, or equal.

3. The finished lining shall have a minimum dry film thickness of 40 mils, except at the gasket groove and spigot end up to six inches back from the end of the spigot which shall be 6 mils dry film thickness, minimum.

4. Lining application shall be performed in strict accordance with the manufacturer's instructions by an applicator approved by the coating manufacturer and under controlled conditions at the applicator's shop or the pipe manufacturer's plant.

## 2.04 PIPE JOINTS

A. Requirements for various types of joints are described in the following paragraphs. UNLESS OTHERWISE NOTED HEREIN OR ON THE DRAWINGS, ALL EXPOSED DUCTILE IRON PIPING SHALL HAVE FLANGED JOINTS.

B. Flanged Joints

1. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges.

2. All flanges and fittings shall conform to the requirements of ASME B16.1.

3. Flanges shall be ductile iron and shall be of the threaded or screw on type.

4. The face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges.

5. Flanged pipe shall conform to the requirements of AWWA C115/A21.15.

6. Pipe lengths shall be fabricated to meet the requirements of the Drawings.

7. Gaskets shall be Toroseal by American Cast Iron Pipe Company, Flange-Tyte by US Pipe, or equal. Gaskets shall be full-face, 1/8-inch minimum thickness cloth inserted rubber, red rubber, neoprene, or superior elastomer and shall be compatible with the fluid being conveyed. Gaskets shall have an allowable maximum working pressure and temperature equal to or greater than the service in which it is installed.

8. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. Bolts used for exposed flanged joints shall be a minimum ASTM A307, Grade B carbon steel, and be in accordance with AWWA C110/A21.10. Bolts used for flanged joints in submerged applications shall be Type 316 stainless steel. All bolts shall have hexagonal heads and nuts of the same material as the bolt. No washers shall be used.

C. Bell and Spigot Joints

1. Bell and spigot pipe shall be provided with push-on, O-ring rubber gasket, compression type joints and shall conform to the requirements of AWWA C111/A21.11. Fittings and specials shall be supplied with mechanical joints as specified for mechanical joint pipe. If required by installation conditions, pipe shall have caston lugs for adequately tying it together.

D. Mechanical Joints

1. Mechanical joints and fittings shall conform to the requirements of AWWA C111/A21.11. Joints shall be made employing a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. If required by installation conditions, pipe and fittings shall have cast-on lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.

2. Bolts for mechanical joints shall be high-strength low-alloy steel tee-head bolts with hexagonal nuts per AWWA C111/A21.11.

3. Mechanical coupling joint pipe and fittings shall be split type, shouldered end. Coupling materials shall be malleable iron. Couplings shall have a minimum pressure rating and service equal to that of the connected piping.

4. Gaskets shall be rubber.

5. After installation, buried couplings shall receive two heavy coats of coal tar epoxy (min. 24 mil thickness) which is compatible with the finish of the couplings.

6. Couplings shall be as manufactured by Victaulic Company of America Style 31, or equal.

E. Restrained Joints

1. Restrained joint pipe shall consist of factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation, and factory welded retainer beads or rings on the spigot of the pipe. All components of the bolted or snap ring assemblies shall be constructed of corrosion-resistant, high strength, low-alloy steel.

2. Restrained joint pipe shall be Flex-Ring or Lock-Ring type joints as manufactured by American Cast Iron Pipe Company, HP LOK or TR Flex as manufactured by US Pipe, Bolt-Lok or Snap-Lok as manufactured by Griffin Pipe Products, TR Flex or Super Lock as manufactured by Clow Water Systems Co., or approved equal.

3. Restrained fittings for piping systems 16-inches in diameter and greater shall have factory restraint systems identical to the factory restrained joint pipe specified above. All fittings shall be minimum pressure Class 250 unless otherwise specified.

4. Restrained fittings for pipe systems 14-inches in diameter and smaller shall be Mechanical Joint fittings with restraint assemblies such as Stargrip by Star Pipe Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, Grip Ring by Romac, or approved equal. Restraint assemblies including all hardware shall be painted with two heavy coats of coal tar epoxy after installation. Where threaded-rods are allowed, the rods and tabs shall be designed for the specified restraint system design pressure, shall have lengths less than 10 feet between fittings, and shall be painted with two heavy coats of coal tar epoxy after installation.

5. The manufactured systems for thrust restraint indicated above shall be used where restrained joint ductile iron pipe and fittings are specified or indicated on the drawings. Gripping gaskets are not an acceptable form of restraint. Thrust restraint and harnessing systems such as threaded-rods, friction clamps, retainer glands shall be used only where specifically specified herein, indicated on the drawings or if allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. Concrete thrust blocks may be used in accordance with the schedule indicated on the drawings, if applicable.

## 2.05 OUTLETS

A. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, the Contractor shall not use taps and shall refer to Section 40 05 00 – Basic Mechanical Requirements for requirements.

## 2.06 POLYETHYLENE ENCASEMENT

A. Wrap all buried ductile iron pipes, valves and fittings with 8-mil polyethylene film per ANSI A21.5/AWWA C105. Use only tube type for pipe. Complete the wrap prior to placing concrete anchors, collars, supports or thrust blocks. Repair polyethylene if damaged during installation.

## 2.07 CAST IRON SOIL PIPE

A. Cast Iron Soil Pipe shall conform to the standards of the CISPI Cast Iron Soil Pipe and Fittings Handbook and ANSI A112.5.1 and A112.5.2 for Hub & Spigot pipe and No-Hub Pipe as appropriate. Pipe class shall be "Extra Heavy:(XH)".

**END OF SECTION**

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## SECTION 40 05 24.23

## STEEL PIPE FOR WATER AND WASTEWATER SERVICE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall submit certification that the steel pipe has been designed to resist all loads implied and reasonably anticipated for the means and methods of installation applied by the Contractor.

B. Design pipe layout in accordance with AWWA M11.

1. Use base stationing and elevation convention as shown on Drawings.

2. Include at minimum:

a. Specific number, location, and direction of each pipe, joint, and fitting. Number each pipe in installation sequence.

b. Station and centerline elevation at changes in grade or horizontal alignment.

c. Location of mitered pipe sections, beveled ends for alignment conformance, butt straps, and temperature stress control joints.

C. Welding Procedure Specification (WPS)

1. Qualified by testing in accordance with ASME Boiler Pressure Vessel Code (BPVC) SEC IX for shop welds and ASME B31.1 and B31.3.

2. Procedure Qualifications Records conducted on unlisted base metal to be production welded as required in the referenced welding Code shall be traceable to heat lots.

3. Written WPS required for welds, both shop and field.

D. Stulling: Design for pipe and fittings such that over-deflection and damage is avoided during handling, storage, and installation, including backfill and compaction.

E. The AWWA specifications referenced in this Section are supplemented as follows:

1. An affidavit of compliance is required from the pipe manufacturer stating the pipe material is manufactured to the requirements of the Specifications and referenced standards.

2. The pipe manufacturer shall include mill specifications on coil steel used in the production of the pipe. The steel manufacturer's certification that the material meets the ASTM specification will be accepted in lieu of tests on specimens taken from the fabricated pipe. The manufacturer may purchase steel plates on the chemical basis and shall submit certified test reports.

## 1.02 DESIGN REQUIREMENTS

A. Contractor shall be responsible for all aspects of installation and testing of welded steel pipe.

B. See Section 40 06 20 – Process Pipe, Valve and Gate Schedules for pipe service conditions.

## 1.03 SUBMITTALS

A. Shop Drawings showing pipe layout including all fittings and straight sections in one complete package from the main pipe supplier.

B. Material list and steel reinforcement schedules for materials specified.

C. Fabrication Information

1. Pipe and fitting details for temporary and permanent facilities indicating:

a. Cylinder thickness

b. Manufacturing tolerances

2. Welded joint details including:

a. Butt joints

b. Miter-cut ends for alignment conformance

c. Fittings

D. Welding Data (Shop and Field Welding)

1. Show on a weld map, complete information regarding base metal specification designation location, type, size, and extent of welds with reference called out for WPS and nondestructive examination numbers in tail of welding symbol.

2. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for all welds.

3. Submit welding data together with Shop Drawings as a complete package.

4. Fittings: Provide a joint weld beveling diagram. Refer to ASME B31.1 and B31.3.

E. Product data for the following:

1. Material data

2. Chemical and physical test reports showing data consistent with specified requirements for each heat of steel proposed for use.

F. Pipe Manufacturer's Written Quality Assurance/Control Plan

G. Statements of Qualification

1. Pipe Manufacturer

2. Fittings and Specials Fabricator

3. Welder Logs

a. Name of welder

b. Welding procedure/positions for which welder is qualified to weld

c. Assigned certification stamp number

d. Certification date

e. Current certification status

4. Contractor's Shop Inspector

5. Contractor's Field Inspection Firm and Personnel

6. Nondestructive Testing Quality Control Firm and Personnel

H. Procedures

1. Shop and field welding information: At a minimum, include complete welding code paper trail with linkage to Shop Drawings.

a. Written WPS and Procedure Qualification Record

b. Written nondestructive testing procedures

c. Current welder performance qualifications

d. Written weld repair procedures for Work

I. Reports

1. Source Quality Control Test Reports: Nondestructive weld testing (shop and field)

J. Design calculations prepared by a Professional Engineer licensed in the state of Georgia for fittings, including opening reinforcement details of collars, wrappers, crotch plates; and harnessed joint assemblies.

**1.04 QUALIFICATIONS**

A. Pipe Manufacturer

1. Steel Plate Fabricators Association (SPFA) Certification of ISO 9000 Certification.

2. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.

3. Demonstrate current production capability for volume of work required for this project.

4. Experience shall be applicable to fabrication plant facilities and personnel; not company or corporation that currently owns fabrication facility or employs personnel.

B. Pipe and Fittings Fabricator

1. Pipe: Successful fabrication of at least 100,000 lineal feet of the same diameter (or larger) and same wall thickness (or greater) within the past five years with the type of joint specified.

2. Fittings: Successful fabrication to AWWA C200 and AWWA C208 standards of at least 25 fittings of the same diameter or larger pipe, with wall thickness 3/16 inch or greater, within the past five years.

C. Welders and Welding Operators

1. Shop Welders: In accordance with ASME BPVC SEC IX

2. Field Welders: In accordance with ASME B31.1 and B31.3

D. Contractor’s Shop Inspector

1. In accordance with AWWA C200

2. Responsibilities

a. Monitor conformance to approved WPS

b. Monitor conformance to approved Nondestructive Testing procedure specifications.

c. Monitor conformance of Welder Performance Qualifications.

d. Provide 100 percent visual inspection before, during, and after shop welding.

e. Coordinate Nondestructive Testing work and review test results.

f. Maintain records and prepare report confirming results of inspection and testing.

E. Pipe Manufacturer Field Representative: The field service representative shall have a minimum of 5 years' experience installing pipe with joints, linings, and coatings of the pipe to be furnished.

## 1.05 DELIVERY, HANDLING, AND STORAGE

A. Fittings shall be marked at each end with "TOP FIELD CENTERLINE".

B. Securely bulkhead or otherwise seal ends of pipe and fittings prior to loading at manufacturing site.

C. Pipe ends shall remain sealed until installation.

D. The Contractor shall ensure the proper protection of piping materials during shipment, handling, storage, and installation as directed by the pipe manufacturer.

E. Damage to pipe and fittings, including linings and coatings shall be repaired to Engineer's satisfaction or removed from Site and replaced.

F. Support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

G. Support on sand or earth berms free of rock exceeding 3-inches in diameter.

# PART 2 – PRODUCTS

## 2.01 MANUFACTURERS

A. Steel pipe and fittings shall be under direction of the main pipe supplier. All straight pipe sections shall be manufactured by the same manufacturer. Fittings may be manufactured by a different manufacturer. Main pipe supplier shall be responsible for coordinating work of other suppliers for either fittings or pipe.

B. All steel pipe shall be supplied by American Spiralweld Pipe Company or Northwest Pipe Company.

## 2.02 STEEL PIPE

A. Steel pipe and fittings shall be manufactured, tested, inspected, and marked to comply with AWWA C200 and additional requirements of these Contract Documents.

B. Materials in contact with internal conveyed liquid shall be NSF 61 approved for use with potable water.

C. Pipe shall be furnished principally in 40-feet net laying lengths with shorter lengths, field trim pieces and closure pieces as required by the Drawings for locations of fittings, or as required for construction.

D. Pipe Barrel

1. The steel pipe shall be mill type, smooth wall, spiral welded, or steel plate for straight seam welded steel pipe per AWWA for nominal pipe sizes 6-inches and larger. Steel pipe shall be new and shall meet or exceed the manufacturer and material requirements of ASTM A139, Grade C, or D, or ASTM A1011/ASTM A1018 Grade 40 or 45. Plates used for reinforcement collars, anchor rings, and crotch plates shall meet or exceed the requirements of ASTM A36 or A572 Grade 50. Steel pipe shall be designed for embankment (wide-trench) conditions and in accordance with AWWA M11 Steel Pipe – A Guide for Design and Installation, latest edition, as supplemented by this Section. and as follows:

    a. Minimum Yield Strength of 42,000 psi

    b. Minimum Tensile Strength of 58,000 psi

2. The inside diameter, including the lining, shall be a minimum of the nominal diameter of the pipe specified.

E. Exposed (indoor and outdoor) steel pipe shall be manufactured to the nominal pipe sizes listed and shall have the following minimum wall thicknesses:

**Exposed Steel Pipe Schedule**

| Nominal Inside Diameter (inches) | Interior Lining Type | Cement Mortar Lining Thickness (inches) | Minimum Sheet or Plate Thickness (inches) |
|---|---|---|---|
| 6 | Cement Mortar Lined | 0.500 | ## |
| 8 to 14 | Cement Mortar Lined | 0.500 | ## |
| 16 | Cement Mortar Lined | 0.500 | ## |

| Nominal Inside Diameter (inches) | Interior Lining Type | Cement Mortar Lining Thickness (inches) | Minimum Sheet or Plate Thickness (inches) |
|---|---|---|---|
| 18 | Cement Mortar Lined | 0.500 | ## |

## 2.03 FITTINGS

A. Fittings shall be fabricated in accordance with AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11.25 degrees (one cut elbow up to 22.5 degrees). If elbow radius is less than 2.5 times the pipe diameter, per the approval of the Engineer, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

B. Specials and Fittings: Unless otherwise shown on the Drawings, shall be made of segmental welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe.

C. Laterals and outlets shall be reinforced in accordance with ASME Pressure Vessel Code, Section VIII, Paragraph G-37 or the latest version of AWWA M11.

D. Fabricate collar or wrapper reinforcement using same steel as specified for main pipe barrel.

## 2.04 INTERIOR LINING

A. Cement Mortar Lining

1. All steel pipe shall be manufactured to include cement mortar lining. Cement mortar lining conforming to AWWA C602 for in-place lining, or AWWA C205 for shop lined applied lining shall be provided. The minimum thickness of the mortar lining shall be as indicated in the pipe schedule. Shop lining of welded joint pipe shall be held back as shown on the Drawings to facilitate welding.

2. Holdbacks shall receive a prime coat and be provided as shown on the approved shop drawings. Holdbacks shall be filled with cement mortar after joint completion per AWWA C205.

3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.

4. Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 Polyurethane.

B. Polyurethane Lining

1. Polyurethane coating shall be per AWWA C222 to a minimum dry film thickness of 25 mils, measured in accordance with SSPC-PA 2. Coating shall be continuous to the ends of the pipe except where field welding is indicated. Holdbacks of lining shall be of sufficient width as to not damage the lining when completing field welds. A heat resistant material of sufficient width to prevent damage to the lining shall be placed on each side of the coating holdback during welding to avoid damage to the lining. Any damage to the epoxy lining shall be repaired per AWWA C222.

C. Epoxy Lining

1. Epoxy Lining shall be per AWWA C210 to a minimum dry film thickness of 16 mills, measured in accordance with SSPC-PA 1. Coating shall be continuous to the ends of the pipe except where field welding is indicated. Holdbacks of lining shall be of sufficient width as to not damage the lining when completing field welds. A heat resistant material of sufficient width to prevent damage to the lining shall be paced on each side of the coating holdback during welding to avoid damage to the lining. Any damage to the epoxy lining shall be repaired per AWWA C210.

D. Exterior Painting for Exposed Steel Pipe (Indoor and Outdoor)

1. Prepare surface to be coated in accordance with the coating manufacturers recommendations immediately prior to applying any coating.

2. Except for areas of pipe to be welded, the exterior of exposed steel pipe shall receive a prime coat of 5 to 10 mils (dry) of inorganic zinc primer rated for 300°F continuous service and shall be Carbozinc 11 as manufactured by Carboline, Tnemec-zinc Series 90-97, or equal.

3. Areas of pipe to be welded shall receive 1 mil (dry) of weldable primer as manufactured by Carboline, Tnemec, or equal. After welding and pressure and leakage testing are completed, welded joints shall be thoroughly cleaned of all foreign matter and any scale or rust and primed as previously specified.

4. Over the prime coat shall be a finish coat of 3 to 5 mils (dry) of a polyurethane coating and shall be Carbothane 133 HB, Tnemec Series 1075, or equal.

5. Field touch-ups shall be electrically inspected by the use of a holiday detector in accordance with AWWA C209.

## 2.05 JOINTS

A. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Drawings.

B. Flanges, Flange Gaskets, and Bolting Materials

1. Flanged joints shall be used as shown on the Drawings. Flanges shall be AWWA C207, standard ring type, slip-on welding flanges.

2. Bolts and nuts shall be per the requirements of AWWA C207. The bolts shall have hexagonal heads and nuts. No washers shall be used.

3. All gaskets shall be the "Ring-Gasket" type, 1/8-inch minimum thickness. Segmented gaskets will not be acceptable. Gaskets for flanged joints must follow AWWA C207.

4. Where isolation is required between dissimilar metals or for cathodic protection, insulating joints shall be provided using isolation gasket kits. Isolating sleeves for bolt holes shall be mylar, and isolating washer material shall be GRE-G10.

5. Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.

C. Lap and Butt-strap Welds

1. Lap welds or butt-strap welds shall be in accordance with AWWA C200, AWWA C206 (for field welding) and AWWA M11.

2. Lap and butt-strap field welded joints shall be used where restrained joints are required or indicated on the Drawings. The minimum lap shall be 1-inch.

3. Lap welded joints shall be welded as shown on the drawings. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings.

4. If pipe restraint is not required, lap or butt-strap or butt welding may be used at the Contractors option.

D. Butt Weld Joints

1. Butt welded joints shall conform to AWWA C200, AWWA C206 (for field welding), and AWWA M11.

2. Butt welded joints shall be used where indicated on the Drawings, or at the Contractor's choice in lieu of lap and butt-strap welds. Butt welds shall be

complete joint penetration welds (applies to single and double welded joint), and the ends of the pipe shall be appropriately beveled for an acceptable butt weld.

3. Butt welds shall be accurately aligned and retained in position during the welding operation so that in the finished joint the abutting pipe sections shall not be misaligned by more than 20 percent of the pipe wall thickness or a maximum of 1/8”, whichever is less.

4. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings.

E. Rolled Groove Rubber Gasket Joints

1. The standard joint for unrestrained steel pipe shall be a rolled groove rubber gasket joint unless otherwise noted on the Drawings. Rolled groove rubber gasket joints shall conform to AWWA C200 and AWWA M11.

2. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.

3. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed 1.00/D where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.

4. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

F. The piping layout shown on the Drawings is based upon standard fittings available in ductile iron pipe. Welded joints will not be acceptable where such joints would interfere with the removal of valves or equipment or create sections of piping too large for removal from structures as determined by the Engineer.

G. Harnessed flexible couplings may also be used in lieu of flanges at locations approved by the Engineer. Lugs or retainer rings shall be welded to the pipe in accordance with the requirements of AWWA Manual M11 for Steel pipe where required for harnessing of flexible couplings.

## 2.06 WELD TESTING AND INSPECTION

A. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

B. All welds made after hydrostatic testing of the straight sections and fittings of pipe shall be tested per the following paragraphs.

C. Shop Non-Destructive Testing

1. 100 percent visually examined by Contractor's Shop Inspector

2. Hydrostatic testing 100 percent of straight pipe sections per AWWA C200

D. Field Non-Destructive Testing

1. All field welds shall be performed by AWS certified welders in conformance with standard procedures and shall be visually inspected and tested by an approved quality assurance testing firm in accordance with ASME B31.1 and B31.3.

2. The Contractor shall be responsible for contracting with an approved testing firm. Nondestructive testing methods shall be used unless otherwise approved by the Engineer.

3. At minimum, all field welds shall be inspected in accordance with the following:

4. Visual: 100 percent of all welds.

a. Magnetic particle or Ultrasonic: 100 percent of all butt welds.

b. Magnetic particle: 100 percent of all lap and butt-strap welds.

c. Hydrostatic testing 100 percent of pipeline per AWWA C200.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. Furnish feeler gauges of proper size, type, and shape for use during installation.

B. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer's instructions and these specifications.

### 3.02 INSTALLATION

A. General

1. Install pipe in accordance with the requirements included in AWWA M11.

2. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

## 3.03 MANUFACTURER'S FIELD SERVICES

A. The services of an experienced, competent and authorized field service representative acceptable to the Owner shall be provided for a period of not less than 3 days to perform all field services specified herein.

B. The field service representative shall visit the site to advise and consult with the Contractor and to review and instruct the Contractor in procedures for pipe handling, laying, and jointing at the start of pipe installation for each crew and shall coordinate his services with the Contractor. The field services representative shall not directly supervise the Contractor's personnel. The Contractor shall remain responsible for the piping installation work.

**END OF SECTION**

## SECTION 40 05 24.43
## STEEL PIPE FOR MISCELLANEOUS SERVICE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. This Section shall apply to steel pipe only for applications as detailed in PART 2.

B. The AWWA Specifications referenced in this Section are supplemented as follows:

1. An affidavit of compliance is required from the pipe manufacturer.

2. The steel manufacturer's certification that the material meets the ASTM Specification will be accepted in lieu of tests on specimens taken from the fabricated pipe.

3. The fabricator may purchase steel plates on the chemical basis only and shall furnish to the Owner certified test reports.

C. All parts of the materials furnished shall be amply designed, manufactured, and constructed for the maximum stresses occurring during fabrication, erection and operation. All materials shall be new and both workmanship and materials shall be of the very best quality, shall be entirely suitable for the service to which they will be subjected, and shall conform to all applicable Sections of these Specifications. Manufacturer's designs shall accommodate all of the requirements of these Specifications.

D. The Contractor shall be responsible for the structural design of the steel and stainless steel pipe, fittings, and couplings. The Contractor shall submit certification that the steel and stainless steel pipe, fittings, and couplings have been designed to resist all loads implied and reasonably anticipated.

E. Reference Section 40 05 00 – Basic Mechanical Requirements.

### PART 2 – PRODUCTS

### 2.01 STEEL PIPE AND FITTINGS FOR NATURAL GAS, PROPANE GAS AND COMPRESSED SERVICE AIR

A. Steel pipe and fittings for natural gas, propane gas and compressed service air shall conform to ASTM A53, black, seamless, Schedule 40 or 80 as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Unless otherwise shown or required, all pipe and fittings shall be threaded. Fittings shall conform to ANSI B16.3, 300-pound class and shall be of the black malleable iron screw type. All threaded joints shall

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conform to ANSI B2.1 with tapered threads at 3/4 inch per foot. Joints shall be made tight with an oil and graphite paste or Teflon thread tape applied to the male threads only. All pipe 1-1/2 inch and smaller shall be reamed to remove scale and dirt.

## 2.02 MISCELLANEOUS STEEL PIPE AND FITTINGS

A. Other steel pipe and fittings not specified elsewhere shall conform to ASTM A53, black or galvanized, as directed by the Engineer, seamless, Schedule 40 or 80 as indicated in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules or as indicated on the Drawings.

B. Unless otherwise shown or required, all piping and fitting shall be threaded. Fittings shall conform to ANSI B16.3, 300-pound class and shall be of the black malleable iron screw type. All threaded joints shall be made tight with an oil and graphite paste or Teflon thread tape applied to the male threads only. All pipe 1-1/2 inch and smaller shall be reamed to removed scale and dirt. Pipe to be galvanized shall have a deep galvanized coating applied in full accordance with ASTM A123.

# PART 3 – EXECUTION

## 3.01 FIELD WELDING OF STEEL AND STAINLESS STEEL PIPING AND FITTINGS

A. Contractor shall minimize the amount of field welding of steel and stainless steel piping required. Locations for pipe field welding will be evaluated and allowed on a case-by-case basis upon written approval of the Engineer. All field welding of steel and stainless steel pipe is subject to the following requirements:

1. Welding shall be performed by AWS-certified welders in conformance with AWS 1.6. Submit welder’s certification for approval prior to performing any field welding.

2. Piping with wall thickness up to 11 gauge (0.125-inch) shall be welded with the TIG (GTAW) process. Heavier walls shall be properly beveled and have a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW) or MIG (GMAW) process. Filler wire of ELC grades only shall be added to all welds to provide a cross-section at the weld equal to or greater than the parent metal. Weld deposit shall be greater than the parent metal. Weld deposit shall be smooth and evenly distributed and have a crown of no more than 1/16 inch on the I.D. and 3/32 inch on the O.D. of the piping or fittings. Concavity, undercut, cracks, or crevices shall not be allowed. Butt-welds shall have full penetration to the interior surface. Excessive weld deposits, slag, spatter, and projections shall be removed by grinding.

3. Jigs shall be utilized to align adjacent sections of piping.

B. Post-Weld Treatment

1. All field welds shall be wire brushed utilizing steel or stainless steel wire brushes to remove slag and spatter. Stainless steel brushes shall be used on stainless steel pipe.

2. The weld and the heat affected area shall be pickled with a brush-on pickling gel in accordance with ASTM A380 to remove all weld residue, oxide, and heat stain from the field weld and affected areas.

3. Pickling of stainless steel pipe shall be done in accordance with pickling paste manufacturer's directions, and areas being pickled shall be protected from direct sunlight. After pickling period is complete, neutralize pickling gel in accordance with directions and rinse area clean.

C. Where field welding of steel (carbon or stainless) piping is approved by the Engineer, all field welds shall be visually inspected and tested by an approved quality assurance testing firm in accordance with ASME B31.1 and B31.3. The Contractor shall be responsible for contracting with an approved testing firm. Nondestructive testing methods shall be used unless otherwise approved by the Engineer. The Contractor shall submit a proposed testing firm and personnel for approval in addition to his proposed plan to visually inspect and test all field welds of steel pipe prior to field welding of steel pipe.

## 3.02 FLUSHING AND TESTING

A. Flushing and testing of all installed low pressure air piping shall be performed as specified in Section 40 05 00 – Basic Mechanical Requirements. The field testing procedure for process air piping shall use air pressure only.

**END OF SECTION**

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## SECTION 40 05 31
## PVC/CPVC PIPE

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

## PART 2 – PRODUCTS

### 2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be manufactured in accordance with ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80 as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D1784 and D1785. Fittings shall conform to the following standard specifications:

1. Socket-Type: (Schedule 40); ASTM D2466

2. Socket-Type: (Schedule 80); ASTM D2467

D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment except at true (double) union valves. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed.

E. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

| Non-Chemical Service | Elastomer Material |
|---|---|
| Non-Potable Water | EPDM |
| Process Drain (Gravity), Vent | EPDM, FKM |
| Process Drain (Pressure) | EPDM, FKM |

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| Non-Chemical Service | Elastomer Material |
|---|---|
| Potable Water | EPDM |

F. Solvent Cement

1. Solvent cement for socket-type joints shall conform to ASTM D2564 for PVC pipe and fittings, unless used in chemical service applications.

2. Solvent cement for PVC socket-type joints in chemical service applications shall be Weld-On 724 as manufactured by IPS Corporation or equal.

3. Primer shall be used for all Schedule 80 piping. Primer shall be Weld-On P-70 as manufactured by IPS Corporation or equal.

G. C900-Class 200 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chloride (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 14 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (±1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression-type joints conforming to the requirements of ASTM D2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 914 psi for all sizes when tested in accordance with D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 985 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. Fittings for C900-Class 200, DR 14 shall be ductile iron, bolted mechanical joint.

H. C900-Class 150 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 – Poly Vinyl Chlorine (PVC) Pressure Pipe and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 18 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20 feet (+/-1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression-type joints conforming to the requirements of ASTM D2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 435 psi for all sizes when tested in accordance with D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 755 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. Fittings for C900-Class 150, DR 18 shall be ductile iron, bolted mechanical joint.

I. PVC pressure rated pipe (PR 160) shall be in sizes between 1 1/2 inches and 12 inches and shall conform to all the requirements of ASTM D1784 and ASTM D2241 and shall be a minimum of SDR 26 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (1± inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed materials shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression-type joints conforming to the requirements of ASTM D2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 135 psi for all sizes when tested in accordance with ASTM D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 500 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. The pipe shall be designed to pass for 1000 hours a sustained test pressure of 340 psi when tested in accordance with ASTM D1598, as referenced in ASTM D2241.

J. Fittings for PR 160, SDR 26 shall be PVC and designed for the pipe being supplied.

K. Acrylonitrile-butadiene-styrene (ABS) shall conform to the requirements of ASTM D2661. Pipe and fittings shall have socket-type couplings with solvent cement joints. Solvent cement shall conform to ASTM D2235.

L. Type PSM polyvinyl chloride (PVC) pipe and fittings shall conform to the requirements of ASTM D3034 with a maximum SDR of 35. Pipe and fittings shall have bell and spigot ends with O-ring rubber gasketed, compression-type joints. Joints shall conform to the requirements of ASTM D3212. Reruns of reclaimed materials shall not be accepted. Unless indicated otherwise, PVC wall pipes shall be provided for all piping passing through exterior walls. Wall pipes shall have a water stop solvent-welded to the pipe. Each wall pipe shall be of the same class and type as the piping to which it is joined.

M. Perforated and closed drainage pipe and fittings shall be rigid PVC pipe, Schedule 40 unless otherwise shown or specified with solvent welded-type joints or approved equal. Pipe shall be slotted or have two rows of 1/4-inch diameter holes spaced 4-inches apart along the circumference of the pipe. Longitudinal spacing of holes shall be 5-inches maximum.

## 2.02 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

A. CPVC shall be manufactured in accordance with ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80 as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. CPVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D1784 and ASTM F441. CPVC fittings shall be socket type conforming to ASTM F439.

D. Solvent Cement

1. Solvent cement for socket-type joints shall conform to ASTM F493 for CPVC pipe and fittings, unless used in chemical service applications.

2. Solvent cement for CPVC socket-type joints in chemical service applications shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

3. Primer shall be used for all Schedule 80 piping. Primer shall be Weld-On P-70 as manufactured by IPS Corporation or equal.

## 2.03 REINFORCED THERMOPLASTIC HOSE AND FITTINGS

A. Reinforced thermoplastic hose shall be clear type, reinforced with polyester yarn. Hose material shall be PVC, EVA (Ethyl Vinyl Acetate), or Low-Density Polyethylene,

depending on the application, as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Hose shall be rated for the following working pressures:

| Internal Diameter | Minimum Working Pressure (at 68°F) |
|---|---|
| ½” | 200 psi (75 psi at 150°F) |
| 1” | 125 psi (50 psi at 150°F) |
| 1-½” | 100 psi |
| 2” | 75 psi |

B. Hoses shall be continuous from the source to the discharge unless shown otherwise on the drawings. Splices shall not be allowed unless approved in writing by the Engineer. If allowed, splices shall occur only in handholes or manholes. Connections and splices, if allowed, shall be barb and clamp type using materials that are compatible with the chemical being conveyed.

C. Reinforced thermoplastic hose shall be a manufactured product of Parker Nexgen or equal.

D. Wetted materials shall be completely resistant to corrosion by the specified chemicals. Hose manufacturer shall guarantee that the hose is suitable for the intended service.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.

B. Plastic piping shall not be installed when the temperature is less than 60 degrees F except as otherwise recommended by the manufacturer and approved by the Engineer.

**END OF SECTION**

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## SECTION 40 05 36.13
## FRP DUCTWORK FOR ODOR CONTROL SERVICE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install fiberglass reinforced plastic (FRP) duct, fittings, dampers, expansion joints, pipe supports, and all appurtenances, complete and in place for odor control service, all in accordance with the requirements of the Contract Documents.

### 1.02 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01 42 00 – References.

B. Commercial Standards

1. ASTM C582 – Standard Specification for Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion-Resistant Equipment

2. ASTM D2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

3. ASTM D2996 – Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe

4. ASTM D3299 - Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks

5. ASTM D3567 – Standard Practice for Determining Dimension of “Fiberglass” (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings

6. ASTM D3982 – Standard Specification for Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Duct

7. NBS PS 15-69 – Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment

8. Or similar international standard(s)

## 1.03 SUBMITTALS

A. Shop Drawings

1. The Contractor shall submit Shop Drawings of FRP piping systems, including duct, fittings, dampers, and all appurtenances in accordance with the requirements in Section 40 05 00 – Basic Mechanical Requirements, Section 01 73 23 – Anchorage and Bracing of Non-Structural Components, and Division 01 – General Requirements, including the following:

   a. Calculations and dimensioned duct layout showing locations of supports, hangers, anchors, guides and expansion joints, sealed by a Professional Engineer licensed in the state of Georgia. The Professional Engineer shall determine the locations required for any supports not detailed on the Contract Drawings, the type of support necessary for that location, and the locations of expansion joints.

   b. Joint fabrication details

   c. Field joint hand layup procedures and details

   d. Shop testing procedure

   e. Detailed shipping and installation instructions

   f. Visual inspection checklist

   g. Recommended bolting torque values for flanged joints

   h. Details for duct supports and calculations, sealed by a Professional Engineer currently licensed in the state of Georgia

   i. Dampers: Manufacturer's product data (materials, construction, dimensions, and installation details) including leakage, pressure drop, and maximum pressure data in accordance with AMCA 500 testing for full range of damper sizes provided

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Manufacturer: Demonstrate a minimum of five projects in service a minimum of 5 years constructed of FRP ductwork. Example projects shall be of a similar size as this Project and shall include ductwork less than 16 inches in diameter.

1. Acceptable Manufacturers include the following:

a. Ershigs/Belco

b. Southeastern Fiberglass

c. Industrial Plastic Systems

d. Perry Fiberglass

e. Daniel Company

f. Engineered Composite Systems (ECS)

g. Ameron International

h. L.F. Manufacturing

i. R.L. Industries

j. Augusta Fiberglass

2. Both the Manufacturer and the installer shall demonstrate experience on at least five projects requiring similar fabrication and installation methods.

B. The Manufacturer shall be responsible for design of the ductwork system, including, but not limited to the FRP ductwork, shear collars, expansion joints, duct/piping supports and anchorage which are not detailed on the Contract Drawings, and other appurtenances for a complete and functioning system. This Section is intended to provide minimum standards only and the final design shall be the responsibility of the Manufacturer. Design shall include all vertical and lateral loads on the ductwork system in accordance with the governing Building Code and shall consider the geometry of the ductwork and location of supports as shown in the Contract Drawings. Design shall comply with requirements of Section 01 73 23 – Anchorage and Bracing of Non-Structural Components. See Structural Drawings for design criteria.

C. Service Conditions

1. The FRP piping system shall be designed and fabricated for odor control service to carry warm moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.

2. The maximum unsupported spans shall be as follows.

| Duct Inside Diameter (inches) | Maximum Span (Feet) |
|---|---|
| 3 through 14 | 10 |
| 16 through 42 | 20 |
| 42 through 96 | 30 |

3. Maximum hoop deflection shall be 1% of the duct nominal diameter, including all service loads.

4. Duct wall thickness shall be designed by the Manufacturer to meet the criteria specified in this Section. The minimum wall thickness for all FRP duct shall be the greater of the calculated thickness or the following:

| Duct Inside Diameter (inches) | Wall Thickness (inches) |
|---|---|
| 3 through 16 | 0.1875 |
| 18 through 36 | 0.3000 |
| 42 through 60 | 0.3750 |
| 72 through 96 | 0.3750 |

5. Resin

a. Resin shall be premium corrosion resistant and fire retardant brominated bisphenol-A vinyl ester. Fillers are only permitted for flame retardance. The product shall have a Class 1 flame spread rating (25 or less). Thixotropic agents can be added to control resin viscosity per resin manufacturer's recommendation.

b. Acceptable resins with no more than 3 percent antimony trioxide shall be:

1) Reichhold Dion 9300 FR

2) Interplastics CoRezyn 8440

3) Ashland Chemical Hetron FR992

4) AOC Vipel K-022

5) Or equal

6. Reinforcement

a. Surfacing veil shall be C glass veil with a silane finish and a styrene soluble binder.

b. Chopped strand mat shall be Type E glass minimum 1-1/2 ounces per square foot with silane finish and styrene soluble binder.

c. Continuous roving for chopper gun spray up shall be Type E glass. Chopper gun is only permitted if an automated process is used. Manual operation of chopper gun shall not be permitted.

d. Woven roving shall be Type E glass minimum 24 ounces per square yard with a five by four weave.

e. Continuous roving for filament winding shall be Type E glass with a silane finish.

D. Construction

1. All FRP ductwork shall be of filament wound or hand lay-up construction.

2. Maximum allowable deflection for any size ductwork shall be 1/2 inch between supports for any size of duct under worst case design conditions.

3. FRP ductwork shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum. FRP ductwork shall be designed for a maximum vacuum pressure of 20 inches w.c. and a maximum positive pressure of 12 inches w.c.

4. Location: Outside or inside as shown on the Drawings.

5. Ambient temperature: 0 to 120 degrees F.

6. Wind and Seismic Loads: Meet requirements shown on the Structural Drawings.

7. Out of roundness of duct shall be limited to +/-1/4 inch for duct sizes greater than 30 inches in diameter.

8. Length of all flanged duct sections shall not vary more than +/-1/2 inch at 70°F.

9. All unflanged duct shall be square on the ends in relation to the center axis within +/-1/8 inch up to and including 24-inch-diameter and within +/-3/16 inch for all diameters greater than 24 inches.

10. Laminates

    a. All ductwork shall have a resin-rich inner surface, an interior corrosion barrier, an interior structural layer and an exterior layer.

    b. Ductwork to meet or exceed requirements of ASTM D3982, ASTM D2996, ASTM D3567, and ASTM C582 or any applicable international standards.

    c. Inner Surface: Minimum 20 mils thick composed of a single ply of the Type C glass surfacing veil embedded in a resin rich surface. Resin content shall be 90%.

    d. Interior Layer: Minimum of at least two layers of 1 ½ oz per square foot chopped strand mat. Resin content shall be 75%. The combined thickness of the inner surface and interior layer shall be a minimum of 100 mils thick.

    e. Structural Layer: Type E glass to meet minimum wall thickness as specified. The total wall thickness includes the inner surface and inner layer. The total wall thickness does not include the exterior layer.

        1) Contact molded structural layer shall include alternate layers of chopped strand mat and woven roving.

        2) Filament wound structural layer shall be preceded by a layer of chopped strand mat or spray chop. The structural layer shall consist of a minimum of three complete cross hatched layers of continuous filaments applied in a helix angle per ASTM D3299.

    f. Exterior Layer: Factory applied paraffinated gel coat with UV inhibitors. Pigmentation shall be determined by the Owner. Pigmentation shall not be added to the exterior layer until visual inspection is completed.

    g. The duct shall have a Barcol hardness of at least 90 percent of the resin manufacturer’s minimum specified hardness for the cured resin when tested in accordance with ASTM D2583.

11. Fittings

    a. All fittings shall be hand-layup construction fabricated from the same resin and having the same strength as the FRP ductwork.

    b. The internal diameter of all fittings shall be equal to the adjacent duct.

    c. The tolerance on angles of all fittings shall be +/-1° up to and including 24-inch-diameter and +/-1/2° for 30-inch-diameter and larger.

12. Elbows

    a. The centerline radius of all elbows shall be 1.5 times the diameter.

    b. Elbows 24-inch-diameter and smaller shall be smooth radius. Elbows 30-inch-diameter and larger shall be mitered. Provide a minimum of two mitered joints for all elbows up to and including 45 degrees and four mitered joints for elbows up to and including 90 degrees.

13. Flanges

    a. Provide flanged connections to dampers, flexible connectors, expansion joints, vessels, demisters, fans, silencers and other locations as shown on the Drawings.

    b. Flanges shall be hand lay-up construction, fabricated from the same resin and having the same ratings as the FRP ductwork. Dimensions shall be in accordance with NBS PS 15-69.

    c. Flanges shall be drilled in accordance with NBS PS 15-69, Table 2. Flange faces shall be suitable for use with full face gaskets. Backs of bolt holes shall be spot faced for a standard diameter washer.

    d. Flange faces shall be perpendicular to the axis of the duct within 1/2 inch.

    e. Flange faces shall be flat to within +/-1/32 inch up to and including 18-inch-diameter ducts and flat within +/-1/16 inch for 20-inch-diameter ducts and larger.

    f. Gaskets shall be EPDM, full face and minimum 1/8-inch-thick.

    g. Provide all Type 316 stainless steel bolts, nuts and washers.

14. Joints

    a. Provide all butt and strap joints in accordance with NBS PS 15-69.

    b. Field weld kits shall be supplied by the duct manufacturer. All necessary fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint.

    c. All resin, catalyst and putty shall be supplied in bulk to complete all field joints plus 25% extra for waste.

15. Provide minimum 1/4-inch buildup of FRP over the duct at each duct support location. FRP buildup shall extend a minimum of 2 inches on either side of the pipe support saddle.

16. Shear Collars

    a. Shear collars shall be provided where specifically called for on Drawings and in additional locations as required to provide for support of the ductwork system.

    b. Shear collars consist of a buildup of FRP over the duct on each side of the duct support to provide longitudinal restraint of the ductwork.

    c. Shear collars shall be considered to be points of fixity in the ductwork system. They shall have sufficient strength to withstand wind and seismic loads on the ductwork acting in any direction for the tributary length of the duct.

## 2.02 EXPANSION JOINTS

A. Provide expansion joints where shown on the Drawings and as required to avoid damage to the duct or equipment. For straight duct runs, locate expansion joints every 75 feet or less. There must be a minimum of one expansion joint in each straight duct run, at the inlet and exhaust of all equipment, and at each duct connection to a fixed structure.

B. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified

C. Material: EPDM

D. Backing Rings: 3/8-inch-thick, 2-inch-wide, Type 316 stainless steel

E. Extension: 1.5 inches

F. Compression: 2.5 inches

G. Lateral Offset: 2.0 inches

H. Thickness: 1/4 inch, minimum

I. Bolts, Nuts and Washers: Type 316 stainless steel

J. Expansion joints shall be manufactured by RM-Holz, The Metraflex Company, Garlock, or equal.

## 2.03 BUTTERFLY DAMPERS

A. Round Fiberglass Reinforced Plastic Dampers

1. All round FRP dampers shall be the butterfly type. FRP fabrication shall meet the corrosion requirements specified in this Section for FRP ductwork.

    a. Dampers used to isolate fans and odor control units shall be bubble-tight dampers.

    b. Unless otherwise noted on the Drawings, the remainder of dampers shall be isolation dampers.

2. Leakage

    a. Bubble-Tight Dampers: Leakage shall not exceed 0 cfm/SF at 30 inches w.g.

    b. Isolation Dampers: Leakage shall not exceed 5.25 cfm/SF at 30 inches w.g.

    c. Control Dampers: Leakage shall not exceed 1% of total airflow at 30 inches w.g.

3. Fabrication

    a. Frame and Blade: Premium vinyl ester resin with minimum 100 mils corrosion barrier

    b. Shaft: Premium vinyl ester for all manually actuated dampers below 20 inches in diameter and Type 316 stainless steel for all dampers 20 inches in diameter and larger

    c. Bearings and Bushings: Teflon

    d. Pins and All Hardware: Type 316 stainless steel

    e. Shaft seals: EPDM

    f. Provide all round dampers with a blade stop consisting of FRP angles with full circumference EPDM seals, mechanically fastened to blade (seal not required for control dampers).

    g. All dampers shall have flanged ends. Flanges per ductwork specifications. Provide Type 316 stainless steel bolts, nuts and washers.

    h. FRP dampers shall be manufactured by Swartwout, Division of Phillips Industries, Belco Manufacturing or equal as follows:

        1) Bubble-Tight: Belco Model 204 or equal

2) Isolation: Belco Model 203, Swartout Model 914 or equal

3) Control: Belco Model 201, Swartout Model 912 or equal

4. Operators/Actuators: Provide manual operators unless otherwise shown on the Drawings.

a. Provide Type 316 stainless steel bracket for mounting actuator.

b. Sizes Smaller than 20 Inches

1) Hand-quadrant actuators, maximum 5-degree increments (or continuous)

2) Type 316 stainless steel

3) Provide locking bolt

c. Sizes 20 Inches and Larger

1) Handwheel with worm gear operators mounted to FRP stand-off plate made integral to damper body

2) Size worm gear operators for pressure rating and torque required by system

3) Maximum 5-degree increments

4) Type 316 stainless steel

5) Provide locking bolt

d. Dampers with centerline of operator located more than 6 feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings. All materials shall be Type 304 stainless steel or better.

5. Electric Actuators: Provide motor-actuated operator where indicated or otherwise shown on the Drawings. Electrically actuated dampers shall be provided with electric actuators in accordance with Section 40 05 51 – Valves, General, Section 40 05 57 – Valve Operators and Electric Valve Operators, and Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

## 2.04 DUCT HANGERS AND SUPPORTS

A. All duct supports, interior and exterior, shall meet the requirements of Section 40 05 07 – Pipe Supports, except that hangers and supports for FRP duct spacing shall be as

specified in Article 2.01, Paragraph C, Item 2 of this Section. Duct spans shall not exceed the duct manufacturer's recommendations.

B. Duct supports located on the exterior of the building shall be designed to include the weight of the duct and to withstand all loads and load combinations required by the governing Building Code, latest edition, of the state/country in which the Project is located, as well as any additional local regulations which are in effect at the time of construction. Exterior supports shall be located as required by the piping system design and shall be per the standard details shown on the Drawings. Where duct support locations are shown on the Drawings, these locations should be considered to be approximate, and the Contractor (via their Professional Engineer) shall be required to confirm the support requirements and locations.

C. The Contractor shall note that not all duct support locations are shown on the Drawings, and the Contractor shall follow the Specifications herein in locating additional supports as required. The Contractor shall be responsible for the design of additional supports and for the overall stability of the entire support system. Support and hanger details and a detailed layout showing the location of all duct supports and hangers shall be submitted in the Shop Drawings and stamped by a registered Professional Engineer licensed in the state of Georgia.

D. Straight runs of duct between expansion joints shall have one shear collar at a fixed support point, unless adequate restraint is provided within the ductwork system.

E. There shall not be less than 1/4-inch buildup of FRP over the duct at each saddle support. FRP buildup shall extend a minimum of 2 inches on either side of the pipe support saddle.

F. Unless otherwise shown on the Drawings, duct supports are to be fabricated from Type 316 stainless steel. All fasteners and anchors shall be Type 316 stainless steel.

G. Provide duct supports on both sides of each expansion joint.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. General: All FRP duct shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary. All installations shall be acceptable to the Engineer. It is recommended that the Contractor obtain the assistance of the duct manufacturer's field representative to instruct the duct fitters in the correct installation and support of all FRP duct. The Contractor shall obtain training by the duct manufacturer's field representative in the correct installation and support of all FRP duct. Instruction shall be a minimum of one 8-hour day.

B. Sloping: All piping shall be installed with sufficient slopes (minimum 1/8-inch per foot) for venting and drainage of liquids and condensate to low points. Provide 1-inch port with CPVC p-trap and CPVC ball valve at each low point for condensate removal.

C. Supports and Anchors: All duct/piping shall be firmly supported in accordance with the requirements of the Specifications. Supports shall be provided where necessary to avoid overstressing equipment, ductwork, or structural members. Expansion joints and guides shall compensate for pipe expansion due to temperature differences. Provide a minimum of one expansion joint in each straight run (maximum spacing is 75 feet between joints for long runs) and at the connections to each structure and entrance/exit to each vessel, piece of equipment, and fan.

## 3.02 DUCT PREPARATION

A. Prior to installation, each duct length shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. All pipe fittings shall be equally cleaned before assembly.

## 3.03 DUCT JOINTS

A. Adhesive Joints: Adhesive joints shall be made with freshly mixed two-part epoxy on clean dry duct ends. The joints shall be made up at the recommended ambient temperatures, to the duct manufacturer’s written recommendations. All duct ends shall be inserted to the full depth of the socket.

B. Flanged Joints: Flanged joints shall be made up in accordance with Section 40 05 00 – Basic Mechanical Requirements.

## 3.04 INSPECTION AND FIELD TESTING

A. Inspection: All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interference, and damage to duct, fittings, and coating. Damage and leaks shall be repaired to the satisfaction of the Engineer.

B. All ductwork shall be leak tested in accordance with SMACNA Air Duct Leakage Test Manual, or appropriate international standard. Duct system shall be sealed to provide a system that is within an allowable leakage limit of 2.5 percent of total air flow at system operating flow and pressure. The ductwork test report shall be submitted to the Engineer.

C. If the system is tested in sections, the leakage rates shall be added to define the performance of the whole system.

D. Check out and certification of the installation and supervision of initial operation related to the FRP butterfly dampers shall be performed in accordance with Section 40 05 51 – Valves, General and Section 40 05 57 – Valve Operators and Electric Valve Actuators and other applicable Sections of these Specifications.

E. Ductwork system shall be tested, adjusted and balanced (TAB) following the general requirements of Section 23 05 93 – HVAC Balancing to provide airflow rates as shown on the Drawings from each individual take-off point within a tolerance of +/-5%. Submit TAB plans and final reports bearing the seal and signature of the Test and Balance Engineer. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

**END OF SECTION**

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## SECTION 40 05 41

## PIPING EXPANSION COMPENSATION FOR LIQUID SERVICE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

### PART 2 – PRODUCTS

### 2.01 EXPANSION/CONTRACTION SYSTEM FOR EXPOSED LIQUID SERVICE PIPING

A. Rubber expansion joints shall be of the single wide arch design and shall be rated for the temperature of the process liquid. Expansion joints for hot water and other process liquids above 150 degrees Fahrenheit shall be rated for a minimum of 250 degrees Fahrenheit. All other applications shall be rated for a minimum of 180 degrees Fahrenheit.

B. Non-submerged joints shall be provided with galvanized ductile iron retaining rings. Exposed expansion joints shall be fully resistant to ultraviolet degradation. Submerged expansion joints shall be fully resistant to attack from organisms or chemicals found in the associated process liquid.

C. Expansion joints shall be located as shown on the Drawings and as indicated in the following table:

| | Minimum Required Movement | | |
|---|---|---|---|
| **Nominal Pipe Diameter (inches)** | **Compression (inches)** | **Elongation (inches)** | **Lateral (inches)** |
| 1 through 1-1/2 | 5/8 | 1/4 | 1/4 |
| 2 through 5 | 1-3/4 | 3/4 | 3/4 |
| 6 through 12 | 1-3/4 | 3/4 | 1 |
| 14 through 20 | 2 | 7/8 | 1-1/8 |
| 24 through 84 | 2-1/4 | 1 | 1-1/8 |

D. Control rods to prevent over extension shall be provided as indicated on the Contract Drawings or as required by the manufacturer. All expansion joints shall be the product of a single manufacturer.

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E. Expansion joints shall be Style 1015 as manufactured by General Rubber Corporation, or equal.

## 2.02 BURIED PIPE EXPANSION JOINTS

A. Buried pipe expansion joints shall be installed at the locations indicated on the Contract Drawings and shall be manufactured from ductile iron, Grade 60-42-10, and conforming to ANSI A21.53 (AWWA C153). Buried pipe expansion joints shall be capable of axial expansion and contraction with a minimum of 4 inches total movement. All joint assemblies shall be furnished preset for a minimum of 2 inches expansion and 2 inches contraction. All pressure containing parts shall be lined with a minimum of 15 mils of fusion-bonded epoxy conforming to AWWA C213. The lining shall also conform to the applicable requirements of ANSI A21.11 (AWWA C111). All bolts used in the assembly shall be stainless steel and coated with coal tar epoxy. The buried pipe expansion joint shall be pressure rated at 350 psi with a minimum safety factor of 3:1 and shall be tested to 350 psi prior to shipment.

B. Buried pipe expansion joints shall be the Ex-Tend expansion joint as manufactured by EBAA Iron Inc., Eastland, Texas, or equal.

**END OF SECTION**

## SECTION 40 05 51
## VALVES, GENERAL

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.

B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM A126 – Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B.

C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125-lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

### 1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Performance tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Shop Drawings conforming to the requirements of Section 01 33 00 – Submittal Procedures, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically

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operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

3. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

## 1.03 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the Owner's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

| Item | Valve/Operator Type | Minimum On-Site Time Requirements |
|---|---|---|
| 1 | Electrically Actuated Modulating Valves | One (1) 8-hour day |
| 2 | Electrically Actuated Open-Close Valves (required only if manufacturer is other than for Item 1) | One (1) 8-hour day |

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day they are at the project.

C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.

D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

## PART 2 – PRODUCTS

### 2.01 FLOW INDICATORS

A. Flow indicators shall be the Akron ball-type as manufactured by Brooks Instrument Co., Fischer and Porter, or equal, and shall have bronze bodies, glass dome, and plastic ball.

### 2.02 CORPORATION STOPS

A. Corporation stops shall be of bronze with tapered male iron pipe threads on inlets and outlets. Terminal outlets shall have screwed bronze hex head dust plugs or caps. Unions shall be used on all corporation stop outlets with connecting piping. Corporation stops shall have a minimum working pressure rating of 250 psi and shall be as manufactured by Mueller Co., Hays Mfg. Div. of Zurn Industries, or equal.

### 2.03 FLOOR BOXES

A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.

B. Two valve operating wrenches shall be supplied in 4-foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F-2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

### 2.04 VALVE BOXES

A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.

B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.

C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4-inch shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e., WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

## 2.05 STRAINERS

A. Stainless steel Y-strainers shall be provided as shown on the Drawings and as specified in the Specifications. All Y-strainers shall be stainless steel except for applications that require PVC or CPVC Y-strainers as shown on the Drawings and specified in following Paragraph B. Strainers shall be full port-full flow design manufactured of Type 304 or 316 stainless steel body. Y-strainers shall be furnished with flanged or screwed ends. The strainer screen shall be 1/32-inch perforation, easily removable, and manufactured of the same material as the valve body.

B. PVC and CPVC Y-strainers shall be provided in PVC and CPVC piping and as shown on the Drawings. Strainer shall be provided with PVC or CPVC body and end cap, EPDM or FKM seal as required for the chemical service, and 20-mesh screen. Temperature rating shall be 30 to 140ºF, and pressure rating shall be 150 psi @70ºF, non-shock. PVC and CPVC Y-strainers shall be as manufactured by Asahi/America, Hayward, or equal.

C. PVC and CPVC simplex basket strainers shall be provided in PVC and CPVC piping as shown on the Drawings. 1/2- through 4-inch strainers shall be one-piece molded body with three ports to facilitate straight-thru flow pattern or u-shape flow pattern as required. Connections shall be true union type to ease installation/future maintenance. The cover, vent plug, and drain plug shall all be hand-removable, requiring no tools. EPDM or FKM seals shall be used as required for chemical service, and internal baskets shall be 1/32-inch perforation (20-mesh) for 1/2- through 1-inch sizes, and 1/8-inch perforation for 1-1/2- through 8-inch sizes. 6- and 8-inch strainers shall be fabricated construction and shall contain flanged connections as standard. The pressure rating for 1/2- through 8-inch sizes shall be 150 psi @70ºF, non-shock. Strainers shall be manufactured by Hayward Industrial Products, or equal.

## 2.06 QUICK DISCONNECT COUPLINGS

A. Quick disconnect type coupling for compressed/service air shall be provided where indicated on the Drawings. Coupling shall provide for instantaneous shutoff in socket end when lines are disconnected. Couplings shall be constructed of Type 316 stainless steel with a Buna-N O-ring and integral safety lock. Couplings shall comply with Military Specification 4109 (interchangeable with standard plug of the same size).

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Except where noted otherwise herein, all valves shall be installed and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the piping Specification Sections. The valves shall be so located that they are easily accessible for operating purposes and

shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.

B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.

C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.

D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.

E. Valve boxes shall be set plumb and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

## 3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.

2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.

3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the

testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer will witness all field testing.

5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

**END OF SECTION**

## SECTION 40 05 57
## VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.

B. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for additional information on valves and operators/actuators.

C. The electric valve actuators shall meet the signal requirements described in Section 40 61 23 – Signal Coordination, Section 40 61 93 – Process Control System Input/Output List, and Section 40 61 96 – Process Control Descriptions.

D. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.

E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.

F. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

### 1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the force required to operate all valves is as specified herein.

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## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Electric actuators shall be provided where specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

B. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.

C. Quarter turn valves 8” and greater in size shall have geared operators. Gate valves 14 inches and greater in size shall have geared operators.

D. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

### 2.02 MANUAL OPERATORS

A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:

1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18 to 24 inches of the surface.

2. Exposed valves up to 6 inches shall be lever operated (except gate valves).

3. Exposed valves 8 inches and larger shall be handwheel operated.

4. Exposed gate valves shall be handwheel operated.

5. Valves with centerline of operator located more than 6 feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.

B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.

C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.

D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for

sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24 inches in diameter.

F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504.

G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch-diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve Specification Section. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90-degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.

H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

## 2.03 ELECTRIC VALVE ACTUATORS

A. Electric Actuators shall be open/close service or modulating service as specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

1. Open/Close (non-modulating) valve actuators shall be IQ series as manufactured by Rotork, M2CP series as manufactured by Bettis (Emerson), QX as manufactured by Limitorque, or SA series as manufactured by AUMA.

2. Modulating valve actuators shall be Type IQM as manufactured by Rotork, M2CP series as manufactured by Bettis (Emerson), QX Modulating as manufactured by Limitorque, or Type SAR as manufactured by AUMA.

B. Performance Requirements

1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.

2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator’s maximum rated breakaway of torque.

3. Operating time for full limits of travel shall be not more than 2 seconds per inch diameter of the valve, +/-50 percent through 20 inches; +/-30 percent for valves 24 inches and larger. Operating time shall not be less than 60 seconds for all modulating valves.

4. Actuators shall be capable of operating in ambient temperatures ranging from 0 to 160 degrees F.

5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of 60 starts per hour without overheating.

6. For modulating actuators, the gearing, motor and contactor shall be capable of 1,200 starts per hour without overheating.

C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 feet of water for 30 minutes. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.

D. The actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing

E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.

F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.

G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force

necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.

H. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460VAC, three-phase, 60 Hz reversible squirrel cage induction type motors and shall be specifically designed for modulating service where indicated on the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degrees C (rise plus ambient). A space heater shall be provided in the motor compartment. The electric motor shall have a time rating of at least 15 minutes at 104 degrees F (40 degrees C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus 10 percent of nameplate rating.

1. Open/Close actuators shall be furnished with electro-mechanical reversing starters.

2. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.

I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.

1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator’s assembly to the valve.

2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and “in step’” with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six contacts, three normally open and three normally closed, shall be supplied at each end of valve travel. Four additional contacts shall be provided to report end of travel or any desired position between ends of travel.

J. Modulating actuators shall have a position feedback potentiometer mounted directly to the valve actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20mA signal corresponding to valve position. Modulating valve actuators shall be designed to respond to either a 4-20mADC analog signal or a digital pulse signal as specified herein or as required to coordinate with the requirements of Division 40.

1. Modulating valve actuators designed to respond to a 4-20mADC signal shall be provided with a valve positioner which shall position the valve proportional to an externally generated 4-20mADC signal. The valve positioning control circuitry shall position the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the “open,” “closed,” or “last” position on loss of 4-20mADC command signal.

2. Modulating valve actuators designed to respond to “pulse” open/close signals shall operate the valve during the time the open or close pulse signal is high. Modulating actuators designed to respond to “pulse” open/close signals shall have the latching circuitry described above for open/close actuators disabled.

K. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two 3/4-inch NPT conduit entries shall be furnished.

L. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.

1. Open, Close, and Stop commands from external dry contacts (utilizing internal 120VAC power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.

2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.

3. Remote Local-Off-Remote (L-O-R) selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote L-O-R selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power.

4. Four unpowered contacts shall be provided which can be selected to indicate valve “Opened” and “Closed” position, “Remote” status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.

5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

M. Local Controls

1. Actuators shall be furnished with a L-O-R selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.

   a. When the L-O-R switch is in the Local position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.

   b. When the L-O-R switch is in the Off position, the actuator shall not operate.

   c. When the L-O-R switch is in the Remote position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.

2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

N. Remote Manual Control Station

1. Where indicated in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls shall include Hand-Off-Auto (H-O-A) selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.

a. When the H-O-A switch is in the Hand position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.

b. When the H-O-A switch is in the Off position, the actuator shall not operate.

c. When the H-O-A switch is in the Auto position, the actuator shall be controlled by remote inputs to the valve actuator from the PLC.

## 2.04 ELECTRIC OPERATORS FOR PVC/CPVC THERMOPLASTIC VALVES

A. Automatic electric operators shall be provided for PVC/CPVC valves where specified and/or as shown on the Drawings. Operators shall operate on 120VAC, single-phase, 60 Hz power and be equipped with solid state electronic internal controls. Motors shall be brushless, capacitor-run, reversing type, suitable for high duty cycle applications and shall be specifically designed for open/close service. Motors shall be provided with integral thermal overload protection with auto-reset. Operator gears and shafts shall be constructed of heat treated high-alloy steel. Operator output shaft shall be electro-less nickel plated. Operator gear trains shall be permanently lubricated. The gear train shall withstand operator stall torque. Operator enclosures shall be NEMA 4. Operators shall be provided with internally wired, thermostatically controlled enclosure heaters to maintain an enclosure temperature of at least 40 degrees F. Operators shall be provided with positive visual position indication markings permanently affixed to the operator body and final output shaft. Operator drive output shall be provided with a declutchable manual override. A manual lever shall be provided for manual valve positioning. Operators shall be failsafe, utilizing a mechanical spring with a clutch mechanism to uncouple the motor during spring return operation, allowing the spring to relax and either open or close the valve. Selection of either fail-opened or fail-closed shall be made by selection of field wiring terminals.

B. Independently adjustable cam-operated position limit switches shall be provided with dry contacts for remote fully opened and fully closed valve position indication. Operators shall respond to external dry contact open/close controls. The actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact open or close signal unless a stop signal is received. The all actuator control circuitry, including latching circuitry, shall be internal to the valve actuator. Valve control circuits and components mounted in a separate enclosure external to the valve actuator assembly will not be permitted. Connections for external remote controls shall be powered from an internal 24VDC or 120VAC power supply. Limit switches shall be rated for 15 amps at 120 VAC. Valve remote status shall also be provided as specified in Section 40 61 96 – Process Control Descriptions. The Contractor shall coordinate operator controls with the functional requirements specified in Section 40 61 96 – Process Control Descriptions.

C. Valve operators shall be provided by the following manufacturers and shall be able to mount to valves specified in Section 40 05 68.13 – PVC and CPVC Valves:

1. Asahi/America

2. Nibco/Chemtrol

3. IPEX

4. Hayward Flow Control

5. Plastomatic

## PART 3 – EXECUTION

### 3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for electric actuators:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 1 |
| Startup | 1 | 1 |

### 3.02 INSTALLATION

A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves and motor controls.

B. Valve actuators shall be factory coated in accordance with the manufacturer's standard paint system.

### 3.03 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.

2. Submit written certification that:

a. Shop tests for the electrical system and all controls were successfully conducted.

b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.

3. Each actuator shall be performance tested, and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:

a. Current at maximum torque setting

b. Torque at maximum torque setting

c. Flash Test Voltage

d. Actuator Output Speed or Operating Time

e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

f. Verification of actuator torque rating with valve.

## 3.04 FIELD TESTS

A. Field testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Valve actuators shall be field-tested together with the associated valves.

2. Test all valves at the operating pressures at which the particular line will be used.

3. Test all valves for control operation as directed.

4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.

3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.

3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.

4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment and General Provisions.

**END OF SECTION**

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## SECTION 40 05 58
## GATE OPERATORS AND ELECTRIC GATE ACTUATORS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.

B. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for additional information on gates and operators/actuators.

C. The electric gate actuators shall meet the signal requirements described in Section 40 61 23 – Signal Coordination, Section 40 61 93 – Process Control System and Section 40 61 96 – Functional Control Descriptions.

D. Gate operators and electric gate actuators shall be designed to unseat, open or close, and seat the gate under the most adverse operating condition to which the gates will be subjected.

E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric gate operator.

F. The gate operators and electric actuators shall be the full and undivided responsibility of the gate manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

### 1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the force required to operate all gates is as specified herein.

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## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Electric actuators shall be provided where specified in the Gate Schedules in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Manual operators shall be provided on all gates which do not receive electric actuators.

B. Manual operators and electric actuators shall be mounted on either a floorstand or a benchstand as specified in the Gate Schedules in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules and as shown on the Drawings.

1. Floorstands shall consist of a cast iron pedestal designed to position the input shaft or handwheel approximately 36-inches above the operating floor. Floorstands shall be of the straight or offset design as specified herein or as shown on the Drawings.

2. Benchstands shall be provided with a rectangular cast iron base machined and drilled for mounting purposes.

C. All operators/actuators shall be provided with a clear, butyrate plastic rising stem cover to protect the rising stem from moisture, dirt, and damage.

1. The stem cover shall not discolor or become opaque for a minimum of 5 years after installation.

2. "Fully Open" and “Fully Closed" positions shall be marked on each cover with mylar labels.

3. Covers shall be graduated in 1-inch increments.

4. The top of the stem cover shall be closed and the bottom shall be designed for easy field mounting to the gearbox.

5. The bottom of the stem cover shall be designed to mount to the gearbox in such a way that all moisture is drained out to protect the stem and gearbox. Accumulated moisture of any amount on top of the gearbox inside the stem cover is unacceptable.

## 2.02 MANUAL OPERATORS

A. Manual operators shall be provided by the gate manufacturer. Manual operators shall be handwheel or handcrank operated as indicated on the Drawings and specified in the Gate Schedule.

1. Manual operation shall require no greater than a 40 pound pull on the crank or handwheel with the specified operating head on the gate.

2. Manual operators shall be provided with a threaded cast bronze lift nut to engage the operating stem. Tapered anti-friction roller or ball thrust bearings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts.

3. Lubricating fittings and extensions shall be provided for the lubrication of all gears and bearings.

4. An arrow with the word "open" shall be permanently attached or cast on the floorstand, benchstand, or handwheel indicating the direction of rotation to open the gate. Unless otherwise noted, all operators shall turn counter-clockwise to open.

5. All sluice gates and slide gates 3 feet wide and larger shall be crank-operated, unless otherwise indicated herein as shown on the Drawings.

B. Handwheel operators shall be furnished without gear reduction. The removable handwheel shall be fabricated steel or cast iron, designed for rough treatment and minimum weight. Handwheels shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24 inches.

C. Crank-operated type manual operators shall have either single or double gear reduction depending upon the lifting capacity required.

1. Crank operators shall be suitable for operation by a portable gate operator.

2. Gearing shall be steel or cast iron with machine cut teeth designed for smooth operation.

3. The pinion shafts on crank-operated floorstands, either single or double, shall be stainless steel, and supported on tapered roller bearings.

4. All components shall be totally enclosed in a cast iron weather-proof housing with cover.

5. Positive mechanical seals shall be provided on the operating nut and the pinion shafts where they extend from the cast iron case or gear box to retain lubricant and to exclude moisture and dirt.

6. The removable crank shall be cast iron with a revolving brass grip.

## 2.03 ELECTRIC GATE ACTUATORS

A. Electric Actuators shall be open/close service or modulating service as specified in the Gate Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

1. Open/Close (non-modulating) gate actuators shall be IQ series as manufactured by Rotork, M2CP series as manufactured by Bettis (Emerson), QX as manufactured by Limitorque, or SA series as manufactured by AUMA.

2. Modulating gate actuators shall be Type IQM as manufactured by Rotork, M2CP Futronic series as manufactured by Bettis (Emerson), QX Modulating as manufactured by Limitorque, or Type SAR as manufactured by AUMA.

B. Performance Requirements

1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.

2. Torque capacity of the actuators shall be sufficient to operate the gates with the maximum pressure differential, as indicated in the Gate Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic gate torque is no more than 60% of the electric actuator’s maximum rated breakaway of torque.

3. The electric actuator shall provide for a gate travel speed of 12 inches per minute unless otherwise approved by Engineer.

4. Actuators shall be capable of operating in ambient temperatures ranging from 0 to 160 degrees F.

5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of 60 starts per hour without overheating.

6. For modulating actuators, the gearing, motor and contactor shall be capable of 1200 starts per hour without overheating.

C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits (including auxiliary switches plus position sensing device where required). The terminal compartment shall be separated

from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 feet of water for 30 minutes. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.

D. The actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing.

E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the gate in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio.

F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the gate at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.

G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.

H. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460VAC, three phase, 60 Hz reversible squirrel cage induction type motors and shall be specifically designed for modulating service where indicated on the Gate Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degrees C (rise plus ambient). A 120VAC space heater shall be provided in the motor compartment. The electric motor shall have a time rating of at least 15 minutes at 104 degrees F (40 degrees C) or twice the gate stroking time, whichever is longer, at an average load of at least 33% of maximum gate torque. Motor bearings shall be permanently lubricated by

premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of gate travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus 10 percent of nameplate rating

1. Open/Close actuators shall be furnished with electro-mechanical reversing starters.

2. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.

I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.

1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed gate and when torque is exceeded during gate travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator’s assembly to the gate.

2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and “in step’” with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six contacts, three normally open and three normally closed, shall be supplied at each end of gate travel. Four additional contacts shall be provided to report end of travel or any desired position between ends of travel.

J. Modulating actuators shall have a position feedback potentiometer mounted directly to the gate actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20mA signal corresponding to gate position. Modulating gate actuators shall be designed to respond to either a 4-20mADC analog signal or a digital pulse signal as specified herein or as required to coordinate with the requirements of Division 40.

1. Modulating gate actuators designed to respond to a 4-20mADC signal shall be provided with a gate positioner which shall position the gate proportional to an

externally generated 4-20mADC signal. The gate positioning control circuitry shall position the gate by comparing the command signal with the present gate position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the “open,” “closed,” or “last” position on loss of 4-20mADC command signal.

2. Modulating gate actuators designed to respond to “pulse” open/close signals shall operate the gate during the time the open or close pulse signal is high. Modulating actuators designed to respond to “pulse” open/close signals shall have the latching circuitry described above for open/close actuators disabled.

K. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two 3/4-inch NPT conduit entries shall be furnished.

L. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.

1. Open, Close, and Stop commands from external dry contacts (utilizing internal 120VAC power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the gate to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.

2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.

3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the gate actuator control power.

4. Four unpowered contacts shall be provided which can be selected to indicate gate “Opened” and “Closed” position, “Remote” status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.

5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

M. Local Controls

1. Actuators shall be furnished with a Local-Off-Remote (L-O-R) selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.

    a. When the L-O-R switch is in the Local position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.

    b. When the L-O-R switch is in the Off position, the actuator shall not operate.

    c. When the L-O-R switch is in the Remote position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.

2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

N. Remote Manual Control Station

1. Where indicated in the Gate Schedules in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls shall include Hand-Off-Auto (H-O-A) selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.

    a. When the H-O-A switch is in the Hand position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.

    b. When the H-O-A switch is in the Off position, the actuator shall not operate.

    c. When the H-O-A switch is in the Auto position, the actuator shall be controlled by remote inputs to the actuator from the PLC.

## PART 3 – EXECUTION

### 3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the

following site visits for electric actuators:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 1 |
| Startup | 1 | 1 |

## 3.02 INSTALLATION

A. All gate actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for gates and motor controls.

B. Gate actuators shall be factory coated in accordance with the manufacturer’s standard paint system.

## 3.03 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.

2. Submit written certification that:

   a. Shop tests for the electrical system and all controls were successfully conducted.

   b. Electrical system and all controls provide the functions specified and required for proper operation of the gate operator system.

3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical gate load and the following parameters should be recorded:

   a. Current at maximum torque setting

   b. Torque at maximum torque setting

   c. Flash Test Voltage

   d. Actuator Output Speed or Operating Time

e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

f. Verification of actuator torque rating with gate

## 3.04 FIELD TESTS

A. Field testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Gate actuators shall be field-tested together with the associated gates.

2. Perform field tests to check and adjust system components, and to test and adjust operation of the overall system, in accordance with Section 46 00 00 – Equipment General Provisions.

a. Preliminary field tests shall be conducted prior to startup.

b. Final field tests conducted during startup.

3. Preliminary and final field tests shall be conducted at a time approved by the Engineer.

4. Test all gates at the operating pressures at which the particular line will be used.

5. Test all gates for control operation as directed.

6. Field testing shall include optimization of opening and closing times of the gates. Gate opening and closing times shall be adjusted based on process requirements to optimize operation of the gates. Final gate opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire gate operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the gate operator system performs according to specifications and that all equipment, gates, controls, alarms, interlocks, etc., function properly.

3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required gate closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.

3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the gates shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.

4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment General Provisions.

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## SECTION 40 05 59.23
## FABRICATED STAINLESS STEEL SLIDE GATES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all fabricated stainless steel slide gates complete with all accessories, special tools, spare parts, mountings, anchor bolts and other appurtenances as specified herein, as shown on the Drawings, and as required for a complete and operating installation. The gates and appurtenances shall be supplied in accordance with the latest edition of ANSI/AWWA C561 – Fabricated Stainless-Steel Slide Gates, except as modified herein. Leakage shall not exceed 0.05 gallon per minute per foot of wet perimeter, which is half the allowable leakage rate listed in the latest revision of AWWA C561.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.

C. Refer to Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for further detail on gate location, dimensions, design criteria, number required, etc.

D. Manual and electric gate actuators (operators) shall be as specified in Section 40 05 58 – Gate Operators and Electric Gate Actuators.

E. The Contractor shall coordinate all details, locations, clearances, and other conditions with the various equipment suppliers, so that the gates function as part of a complete system.

### 1.02 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings, in accordance with or in addition to, the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop drawings showing dimensions, general construction, and materials used for all parts of the gate and gate appurtenances. These drawings shall include sufficient detail to determine if the proposed equipment meets the requirements specified herein and must include individual drawings for each typical gate to be provided.

2. Certification that submitted gates are in accordance with the latest edition of AWWA C561, except as modified herein.

3. Design calculations demonstrating anchor bolt sizing and spacing in compliance with AWWA C561.

11-02-21

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Subject to compliance with the Specifications, provide products manufactured by Fontaine-Aquanox Water Control Products; Hydro Gate (Mueller Co.); Rodney Hunt Company (JASH USA); RW Gate Company; Waterman; or Whipps. The same manufacturer shall furnish all fabricated stainless steel slide gate assemblies.

B. The gates and appurtenances shall be designed for installation in the structures shown on the Drawings.

C. Gates shall be configured as self-contained or non-self-contained and shall be designed to mount directly to concrete (surface mounted or embedded) or to a thimble (E, F, or MJ), as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

D. Gates shall be either submerged or free surface gates as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

1. Submerged gates shall be sealed on all four sides.

2. Free surface gates shall be sealed on the bottom and both sides.

E. Gates shall be either flush bottom or conventional closure as shown on the Drawings.

F. Gate actuator shall be as identified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

G. Stainless steel nameplates shall be permanently attached to each pedestal (floor stand), yoke (bench), or torque tube (bench stand), indicating gate invert elevation, the Owner's gate tag number per Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, and the Manufacturer's identification number.

### 2.02 FRAME AND GUIDES

A. The guides shall be integral with the frame. The frame assembly, including the guide members, invert member, and yoke member, shall be constructed of formed stainless steel plate with a minimum thickness of 1/4 inch.

B. Flush-bottom closure type gates shall have a replaceable compressible resilient seal attached to the invert member of the frame. The seal shall be held in place with a retainer bar or molded into the frame invert. Designs that require the invert seal to be mounted on the slide shall not be allowed.

C. The guides shall be provided with holes for anchor bolts at a maximum spacing of 18 inches.

## 2.03 SLIDE

A. The slide (disc) shall be stainless steel plate reinforced with structural shapes of the same alloy welded to the plate.

B. Slide deflection shall not exceed 1/720 of gate width at maximum design head, or 1/16 inch, whichever is less.

## 2.04 ACTUATOR SUPPORT/MOUNTING

A. Self-contained gates shall be provided with a yoke machined to receive either a baseplate or torque tube for actuator mounting. The yoke shall be formed by two angles or channels welded at the top of the guides to provide a one-piece rigid frame. The arrangement of the yoke shall be such that the stem and slide can be removed without disconnecting the yoke. At maximum operating load, yoke deflection shall not exceed 1/720 of gate width, or a maximum of 1/4 inch, whichever is less.

B. Non-self-contained gates shall have a pedestal mounted to a reinforced concrete slab or reinforced concrete haunch, aligned with the gate stem.

## 2.05 STEMS AND STEM GUIDES

A. Unless otherwise indicated on the Drawings, all gates shall be rising stem.

B. Operating stems shall be designed to transmit in compression at least 2.5 times the rated output of the operating mechanism with a 40-pound effort on the crank or handwheel, or 2.0 times the stalled motor torque of the electric actuator, whichever is greater.

C. Stem design calculations shall use the stem minor diameter for calculating stem cross sectional area and stresses due to compression and tension loads.

D. Keys or pins shall be stainless steel materials matching the alloy of the gate stem. All threaded and keyed couplings of the same size shall be interchangeable.

E. Gates wider than 48 inches and having a width greater than twice the height shall have dual stems. Any gates not meeting these criteria shall have a single stem unless otherwise designated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Dual stem gates shall be equipped with two lifting mechanisms connected with a jackshaft for synchronization. The jackshaft shall be constructed of the same material as the stems.

F. Stem guides shall be adjustable in two directions and shall be placed according to Manufacturer’s recommendation, but in no case shall spacing exceed 10 feet on center. In addition, stem slenderness ratio (l/r) shall not be greater than 200.

G. Rising stem gates shall be provided with an adjustable stop collar on the stem above and below the actuator lift nut. Collars below the nut shall not be required for self-contained gates where the frame height equals the gate height plus the range of travel of the slide.

## 2.06 WALL THIMBLES

A. Wall thimbles shall be provided when required by Section 40 06 20 – Process Pipe, Valve, and Gate Schedules and shall be designed per the design head of the associated gate as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

B. For compatibility, all wall thimbles shall be supplied by the gate manufacturer and shall be stainless steel of the same alloy as the gate.

C. Wall thimbles shall be full wall depth and shall be “F” Type, “E” Type, or “MJ” Flange-Bell Type, as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

D. Type “E” thimbles shall be used to connect to piping and shall be machined with tapped holes for the connecting pipe flange attaching studs.

E. Wall thimbles shall be internally braced during installation and shall be flush-mounted, unless otherwise recommended by the gate manufacturer.

F. The gate mounting (front) flange shall be machined with tapped holes for the gate frame attaching studs and have metal stamped vertical centerlines with the word “top” for correct alignment.

G. Square-bodied thimbles shall be provided with holes in the invert to allow satisfactory concrete placement behind the thimble.

H. A permanent hard-setting mastic or polyurethane closed cell foam gasket of uniform thickness shall be provided between the gate and the wall thimble. Alternatively, the gate manufacturer may provide precision machined mating surfaces between the gate frame and wall thimble and apply a mastic material to the surfaces to provide an acceptable seal. Regardless of the method used to seal the joint between the gate flange and the wall thimble, the final assembly shall meet the leakage criteria specified herein.

## 2.07 MATERIALS

A. Materials for gates shall conform to the following specifications:

| Component | Material of Construction |
|---|---|
| Frame Assembly Yoke, and Retainers | Stainless Steel, Type 316L, ASTM A240 |
| Slide and Stiffeners | Stainless Steel, Type 316L, ASTM A240 |
| Stem and Anchor Studs | Stainless Steel, Type 316, ASTM A276 |
| Stem Couplings and Stop Collars | Stainless Steel, Type 316, ASTM A276 or<br>Bronze, ASTM B584 (UNS C87200 or C87300) |
| Fasteners and Nuts | Stainless Steel, Type 316, ASTM F593/F594 or ASTM A276 |
| Invert Resilient Seal | Neoprene or EPDM, ASTM D2000 |
| Gate Seat/Seals and Facing | UHMW Polyethylene, ASTM D4020 |
| Non-Rising Stem Thrust Nuts | Bronze, ASTM B584 (UNS C86500, C87200, or C87300) or<br>Bronze ASTM B505 (UNS C95800) |
| Actuator Lift Nuts | Bronze, ASTM B584 (UNS C86300 or C86500) or<br>Bronze ASTM B505 (UNS C95800) |
| Pedestal and Actuator Wall Brackets | Stainless Steel, Type 316L, ASTM A276 |
| Actuator Housing | Cast Aluminum or Ductile Iron |
| Stem Guide Brackets | Stainless Steel, Type 316L, ASTM A276 |
| Stem Guide Bushings | UHMW Polyethylene, ASTM D4020 |

# PART 3 – EXECUTION

## 3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for each series of gates:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 1 |
| Startup | 1 | 1 |

## 3.02 INSTALLATION AND TESTING

A. Installation: The gates shall be set carefully in the locations shown on the Drawings in accordance with the installation manual furnished by the gate manufacturer.

1. The stems shall be provided with wall-mounted guides where required.

2. All gates shall be operated and tested to ensure proper installation.

B. Concrete Surface Mounting/Grouting: once gate has been properly anchored per manufacturer's requirements, gate shall be formed and grouted with flowable non-shrink grout per Section 03 60 00 – Grout to fill all voids between gate frame and wall. Dry packing of grout shall not be considered acceptable.

C. Testing: The completely assembled and installed gates shall be inspected for proper seating.

1. The gate slide shall be fully opened and closed in its guide system to ensure that it operates freely.

2. Pedestals shall be shop-operated to ensure proper assembly and operation.

D. All gates shall be certified that at the operating head conditions indicated in the Gate Schedule, leakage shall not exceed 0.05 gallon per minute per foot of wet perimeter.

## 3.03 PAINTING

A. All ferrous parts, except stainless steel, of the gates and stem guides shall be blast-cleaned and painted in accordance with Section 09 90 00 – Painting.

B. All machined iron surfaces, including drilled and tapped holes, shall be coated with a protective grease.

C. The surfaces of the wall thimbles in contact with concrete shall remain uncoated.

**END OF SECTION**

## SECTION 40 05 61
## GATE VALVES (INCLUDING KNIFE GATE VALVES)

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. The Contractor shall furnish and install, complete with all assemblies and accessories, all gate valves shown on the Drawings, specified herein and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

C. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications.

### 1.02 SUBMITTALS

A. As required in Section 40 05 51 – Valves, General and Section 01 33 00 – Submittal Procedures.

B. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications.

### PART 2 – PRODUCTS

### 2.01 GATE VALVES

A. Metal Seated Gate Valve (GV-MS)

1. Size: 2 to 4 Inches (Iron Body)

a. Gate valves shall be iron body, bronze trimmed, bolted bonnet, bolted packing gland, wedge disc, and minimum 150-psi non-shock cold water pressure rating. Meets or exceeds MSS SP-70. Exposed valves shall be of the outside screw and yoke (OS&Y), ANSI B16.1, 125-pound flanges and shall be as manufactured by the Crane Company, Jenkins Bros. Corp., or equal.

2. Size: Less than 2 Inches (Bronze Body)

a. Gate valves shall be of bronze body, threaded bonnet, non-rising stem (NRS), packed gland, solid wedge disc and minimum 300-psi non-shock cold water pressure rating. Valves shall have screwed ends or as specified

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otherwise and shall be manufactured by Crane Company, Jenkins Bros. Corp., or equal.

B. Resilient Wedge Gate Valve (GV-RW)

1. Size: 4 to 12 Inches

a. Gate valves shall be rated for 250 psig working pressure.

b. Non-rising stem (NRS) design, shall fully comply with the requirements of AWWA C509 for resilient-seated gate valves and shall be manufactured by Kennedy Valve, Clow, or equal.

c. Gate valve body, bonnet, and wedge shall be cast iron conforming to ASTM A126, Class B. All pressure retaining joints shall be sealed with O-ring seals. Flat gaskets shall not be acceptable.

d. Stems and stem nuts shall be bronze. Stems shall contain integral thrust collars. NRS valves shall contain two O-rings above the stem thrust collar and one O-ring below the stem thrust collar. All stem O-rings shall be replaceable with valve in the full open position and subjected to full pressure. NRS stems shall have two low-friction thrust washers located above and below the stem collar to reduce operating friction.

e. Wedge shall be totally encapsulated with a permanently bonded rubber material. Rubber shall be suitable for use in wastewater and shall be EPDM.

f. Waterway shall be smooth, unobstructed, and free of all pockets, cavities, and depressions in the seat area.

g. Body, bonnet, and stuffing plate shall be shop coated inside and out with a fusion bonded epoxy (10 mils minimum dry film thickness) complying with AWWA C550 and shall be NSF-61 certified. Damage surfaces shall be repaired in accordance with the manufacturer’s recommendations.

h. Valves shall be flanged or mechanical joint as shown on the drawings. Provide 2-inch-square standard AWWA operating nut unless otherwise shown on the Drawings or specified herein.

i. All valve assembly hardware shall be minimum 304 stainless steel.

C. Knife Gate Valve

1. Standard Knife Gate Valve (GV-SK)

a. Valve shall be heavy-duty fabricated, bonneted knife gate type with flanged connections in accordance with ANSI B16.5, 150-pound flange, integral seat,

and round port, rated for minimum 100 psi in bidirectional, dead-end service. Body shall be of solid ASTM A240 Type 304 stainless steel construction. All wetted parts shall be Type 304 stainless steel. Bonnet shall be of the same material and pressure rating as the body. Valve shall have a handwheel operator and shall be as manufactured by:

1) Dezurik/Hilton, H-200-B

2) ITT Fabrivalve, Style F134

3) Red Valve

4) Or Approved Equal

b. Body port area shall not be less than ninety percent of nominal pipe diameter. Washout ports and drains shall be provided pre-piped with minimum 1/2-inch-diameter for valves up to 20 inches and 3/4-inch-diameter taps for valves 24 inches and greater. Provide adaptors for 1-1/4-inch hose connection for complete flushing of the body.

c. Gate bottom shall be a knife-like, beveled edge and shall push aside and cut through wastewater solids in the flow to assure positive seating.

d. Gate guides shall be welded in and machined. Gate jams/wedges shall be provided to assure positive seating and minimize leakage.

e. Chest buttons or wedges shall be provided to assist in holding the gate against the seat and optimize shutoff.

f. Stem shall be Type 304 stainless steel and shall have single pitch threads.

g. Yoke shall be heavy duty, one piece, ASTM A106, Type 304 stainless steel construction. Yoke sleeve/nut shall be ASTM B62 bronze.

h. Stem packing shall consist of multiple layers of square braided acrylic/PTFE packing for the valves. Packing shall be impregnated with marine, petroleum base, or Teflon lubricants. Packing shall seat around the stem and shall be replaceable externally. No internal packing shall be allowed.

i. Packing gland shall be ASTM A240, Type 304 stainless steel, plastic coated cast iron.

j. Gland bolts shall be easily accessible.

k. Electric actuators for Open/Close service shall be provided where indicated in the Schedule.

l. Valve and actuator shall be provided with roller guides plus all additional options and accessories required where necessary for proper installation in the orientations shown on the Drawings.

m. ASTM A276, Type 304 stainless steel stem extension and painted carbon steel floorstand shall be provided where shown on the drawings or as otherwise specified.

**END OF SECTION**

# SECTION 40 05 62
# ECCENTRIC PLUG VALVES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

### 1.02 SUBMITTALS

A. As required in Section 40 05 51 – Valves, General, and Section 01 33 00 – Submittal Procedures.

B. Performance tests shall be conducted in accordance with the latest revision of AWWA C517 and affidavits shall conform to the requirements of the Specifications.

## PART 2 – PRODUCTS

### 2.01 ECCENTRIC PLUG VALVES

A. General

1. Plug valves shall be of the non-lubricated, eccentric seating plug type with synthetic rubber-faced plugs as manufactured by DeZurik Company, Clow, or equal.

2. All valves shall be provided with limit stops and rotate 90º from fully-open to fully-shut.

3. The minimum working pressure shall be 175 psi for valves 12 inches and smaller and 150 psi for valves 14 inches and larger. Seat shall be hydrostatically tested to the valve design working pressure. Shell hydrostatic test pressure, with plug open and valve ends sealed, shall be 150 percent of the valve rated working pressure in accordance with AWWA C517.

4. Valve body shall be epoxy-coated ductile iron, cast iron or semi-steel, unless specified otherwise, and coated as specified herein.

5. Seats shall have a welded overlay of 1/2-inch-wide, 90 percent pure nickel and machined to a finish containing no stress cracks. Minimum overlay thickness shall be 1/8 inch. The plug shall contact only the raised nickel seat surface.

6. Plug facings shall be of Chloroprene, Nitrile Butadiene, or equal, and completely suitable for use with domestic sewage.

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7. The shaft seal shall be V-Type with minimum four sealing rings and a follower ring. Stuffing box shall be designed with a space between the bonnet and actuator so that packing can be inspected, adjusted, and replaced without removing the valve actuator.

8. Bearings shall be sleeve type with the following materials.

   a. Sizes 4 through 18 Inches: Sintered, oil impregnated, permanently lubricated Type 316 stainless steel

   b. Sizes 20 through 36 Inches: ASTM A743, Grade CF8M

   c. Greater than 36 Inches: Upper and lower plug journals fitted with ASTM A240 Type 316 stainless steel, with body bearings of ASTM B30, Alloy C95400 aluminum bronze

9. Provide PTFE ring on the shaft between plug and body to serve as a thrust bearing and grit excluder.

10. All buried valves shall have mechanical joint ends (unless otherwise shown), conforming to ANSI A21.11 (AWWA C111), and shall be operated with a standard AWWA 2-inch square nut through a totally enclosed worm gear actuator. Valve boxes shall be installed with all buried plug valves and shall be as specified herein.

11. Unless otherwise shown, all exposed valves 4 inches in diameter and larger shall have flanged ends conforming to ANSI B16.1, 125/150-pound standard with face-to-face dimensions of standard plug valves. Valves smaller than 4 inches in diameter shall have screwed ends, unless otherwise noted.

12. Valves 8 inches in diameter and larger shall be handwheel or floorstand-operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Valves 6 inches in diameter and smaller shall have lever operators, unless otherwise specified or noted on the Drawings. Manual operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.

13. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under the specified pressures and flow conditions.

14. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

15. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium

epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

16. Valves installed in potable water applications and where specified shall be NSF/ANSI 372 certified lead-free and NSF/ANSI 61 certified for drinking water.

B. Full Port Eccentric Plug Valve (PV-FP)

1. Port shall be rectangular shaped cross section designed to seat with a cylindrical plug. Port cross-sectional area shall be equal to or greater than the cross-sectional area of the upstream pipe.

2. The flow passage through the valve body shall have a cross-sectional area equal to or greater than the cross-sectional area of the upstream pipe at any point along the valve flow axis.

3. Plug shall have a cylindrical seating surface and eccentrically offset from the center of the shaft. Plug shall not contact seat until at least 90 percent closed.

C. Partial Port Eccentric Plug Valves (PV-PP)

1. Port shall be rectangular shaped cross section designed to seat with a cylindrical plug.

2. Plug shall have a cylindrical seating surface and eccentrically offset from the center of the shaft. Plug shall not contact seat until at least 90 percent closed.

## PART 3 – INSTALLATION

### 3.01 GENERAL

A. Install in accordance with the manufacturer’s recommendations.

B. In applications with suspended solids in the liquid or for dirty gases:

1. Vertical Pipelines: Install valve with the seat end at the top.

2. Horizontal Pipelines: Install valve so plug rotates upwards when opening. Higher pressure side of the valve, when closed, shall be on the valve end opposite of the seat.

C. In applications with clean liquids or gases install the valve with the higher-pressure side of the valve, when closed, on the opposite end of the valve from the seat.

**END OF SECTION**

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## SECTION 40 05 63
## BALL VALVES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves required for chemical service shall be constructed of materials suitable for the intended service.

### PART 2 – PRODUCTS

### 2.01 METAL SEATED BALL VALVE FOR WATER SERVICE (BLV-MS)

A. Ball valves for water service shall be of the full port, single seated, metal to metal seated, tight-closing type conforming to the latest revision of AWWA C507 Specifications. The manufacturer shall have a minimum of 5 years of experience in manufacturing ball valves of the sizes required in accordance with AWWA C507 Specifications. All ball valves shall be the product of one manufacturer. Ball valves shall be as manufactured by Willamette Valve, Inc., or equal.

B. Each valve shall be performance and leak tested as specified in AWWA C507 revised as follows: In addition to the testing requirements of AWWA C507, each ball valve shall be thoroughly cleaned and opened and closed at least three times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.

C. Ball valves shall be AWWA Class 150, unless otherwise indicated in the valve schedules, design with flanged ends, and installed as shown on the Drawings.

D. The valve body shall be constructed of epoxy coated cast iron conforming to ASTM A48, Class 35, with a full, unrestricted circular inlet and outlet, with nominal opening diameter equal to the rated size of the valve. Each valve body shall be provided with flanged ends conforming in diameter and drilling to ANSI B16.1, Class 125. All flanges shall be flat faced and finished to true plan surfaces within a tolerance limit of 0.005 inch. Each flange face shall be perpendicular to the longitudinal axis of the valve within a maximum angular variation tolerance of 0.002 inch per foot of flange diameter. Flange faces shall have concentric or spiral serrated finish. The body trunnions shall be fitted with ample sized bronze bearings of sufficient difference in hardness from the plug bearings to eliminate seizing and galling. Bearing pressure shall not exceed 1500 psi at full differential pressure of 150 psi. Valve designs employing Teflon-coated or other

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non-metallic material will not be acceptable. Bearings shall be machined in accurate alignment for reception of the plug trunnions.

E. The body shall provide rigid means for supporting the valve operating mechanism without the necessity of additional supports and shall be of such design that it shall be capable of receiving the complete plug sub assembly. The valve body shall have integral hubs for housing shaft bearings and seals.

F. The body shall have a rigidly attached metal seat. The body seat shall be Monel (Alloy 400) and shall be machined, ground, and polished for contact with the stainless steel seat mounted on the plug.

G. There shall be two pipe connections, one for an air vent and the other for drain.

H. The plug shall be constructed of epoxy coated cast iron conforming to ASTM A48, Class 35, with a full unobstructed, circular waterway with a diameter equal to the rated size of the valve. It shall have trunnion supports cast integral on the axis of rotation. An extension of one trunnion, called the operating shaft, shall pass through a shaft seal chamber, and connect to the valve operation mechanism.

I. The plug shall have a stainless steel seat conforming to ASTM A276, Type 304, mounted thereon which shall properly align with the body seat when the valve is in the closed position. The surfaces of the seat ring shall be spherically generated and shall be machined, ground, and polished for contact with the body seat.

J. The plug trunnions shall be fitted with bronze bearings of sufficient difference in hardness from the body bushings to eliminate seizing and galling.

K. Bearing pressure shall not exceed 1500 psi at full differential pressure of 150 psi. Valve designs employing Teflon coated or other non-metallic bearing material will not be acceptable.

L. Valve shafts shall be integral with the plug and shall connect the plug to the torque unit. The shaft shall be of chrome Molybdenum Steel (ASTM A322, Grade 4140) with hard chrome plate through the seal chamber suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve plug by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e., mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.

M. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of heavy-duty bronze. The valve assembly shall be furnished with a factory set thrust bearing designed to center the valve plug in the valve seat at all times. End cover bolts shall be of stainless steel construction.

N. A shaft seal shall be provided of the type utilizing a plug shaft stuffing box, four "O" ring seals, a bronze retainer, and a corrosion resistant steel lock ring. The "O" ring material shall be Buna-N rubber, as intended for use with potable water or wastewater.

O. Manual operators for ball valves 18 inches in diameter or larger shall be the worm gear or travelling nut type conforming to AWWA C507. Manual operators for ball valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule. Electric motor operators shall be as specified elsewhere in this Section.

P. The torque unit (valve operating mechanism) shall be of the traveling-nut type and shall be the product of the valve manufacturer. The assembly shall be mounted and attached to the valve body. The torque unit shall be designed to accept a manual, cylinder, or electric motor actuator. The torque unit housing shall employ the following:

1. A traveling crosshead to impart positive rotary movement to the plug which will move transversely to the valve shaft

2. A cylinder piston rod or threaded Type 416 stainless steel leadscrew (reach rod or stem) with the crosshead directly attached thereto

3. A rotator lever (of cast steel construction)

4. A matched set of interconnecting links (of cast steel construction) connecting the traveling crosshead to the rotator lever

Q. The traveling crosshead shall be confined to permit linear motion only and to prevent it from any tendency to rotate due to linkage reaction. A plug shaft support bearing shall be supplied on the cover.

R. The torque unit shall be so designed that during the first 50 percent of stroke in closing the flow area is reduced by approximately 81 percent. The remaining 19 percent of flow area shall be gradually reduced to a complete shutoff throughout the last 50 percent of the closing stroke.

S. The torque unit shall be totally enclosed in a suitable housing with a removable cover and shall be capable of being inspected, lubricated, adjusted, and repaired without interfering with or removing the valve from the line and shall be permanently lubricated. All parts shall be of first class workmanship, easily replaceable and manufactured of the best materials suited for the purpose. All parts subject to rubbing shall be of significantly different hardness to prevent galling and shall be sized to result in a maximum bearing

stress at full load of 2,000 psi. The main shaft shall be replaceable without removing the torque unit housing and while the valve is in the line under pressure.

T. The manufacturer shall certify that the ball valves are capable of operating in continuous duty service under these pressures and flow conditions.

U. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

V. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

## 2.02 BALL VALVE FOR SERVICE AIR (BLV-SA)

A. Ball valves for service air shall be manufactured by Apollo Ball Valve Division of Conbraco Industries, Inc., Pageland, SC., or equal. The body materials shall be cast bronze rated at 600 psi WOG, 150 psi saturated steam. Valves shall be tested by the manufacturer to MSS SP-72, 100 psi air under water, in the opened and closed position. The valve shall provide a port diameter equal to or exceeding the mating pipe size. Valves 2-1/2 inches in diameter and smaller shall have lever operators, unless otherwise specified herein or noted on the Drawings. Levers shall be cadmium plated steel covered with a vinyl grip and attached with a nut and have a hole for tagging purposes. The stem gland shall be adjustable and independent of the lever to compensate for wear. Bottom loaded stems shall be designed to be blow-out proof. The stuffing box seals and ball seats shall be composed of glass-reinforced TFE. The ball and stem shall be Type 316 stainless steel. Ball valves shall have NPT ends.

## 2.03 THREADED STAINLESS STEEL BALL VALVES

A. Two-Piece Ball Valve (BLV-2P)

1. 3-Inch and Smaller

a. Threaded ends, 2-piece, full port, stainless steel design manufactured to MSS SP-110.

b. Blow-out proof stem, RPTFE stem bearing, two position locking vinyl grip stainless steel lever operator, compression controlled RPTFE body seals, and adjustable multi-piece PTFE “V” style packing.

c. Rated for 1000 psi CWP.

d. Manufacturer: Apollo 76F-100 Series or Approved Equal.

B. Three-Piece Ball Valve (BLV-3P)

1. 2-Inch and Smaller

a. Threaded ends, 3-piece, full port, stainless steel design manufactured to MSS SP-110.b. Blow-out proof stem, two position locking vinyl grip stainless steel lever operator, compression controlled RPTFE gaskets, and adjustable multi-piece PTFE “V” style packing.

b. Rated for 1500 psi CWP.

c. Manufacturer: Apollo 86A-100 Series or Approved Equal.

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 40 05 64
## BUTTERFLY VALVES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

### PART 2 – PRODUCTS

### 2.01 BUTTERFLY VALVE (BFV) FOR WATER SERVICE

A. Butterfly valves (water service) shall be rubber-seated, tight-closing type conforming to the latest revision of AWWA C504. The manufacturer shall have a minimum of 5 years of experience in manufacturing butterfly valves of the sizes required in accordance with AWWA C504. All butterfly valves shall be the product of one manufacturer. Butterfly valves shall be as manufactured by Pratt, Mueller Co., DeZurik, GA Industries, or equal. Each valve shall be performance and leak tested as specified in AWWA C504 revised as follows: In addition to the testing requirements of AWWA C504, each butterfly valve shall be thoroughly cleaned and opened and closed at least three times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.

B. Butterfly valves shall be Class 150B, unless otherwise indicated in the valve schedules, and of the short body design with mechanical joint or flanged ends, as shown on the Drawings.

C. Valve bodies shall be epoxy-coated cast iron conforming to ASTM A126, Grade B, ASTM A48, Class 40 or ductile iron conforming to ASTM A536, Grade 65-45-12. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals.

D. Butterfly valves shall be of the concentric or eccentric shaft types. Valve discs shall be constructed of epoxy coated ductile iron, ASTM A536, Grade 65-45-12. Discs shall provide a full 360-degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the fully open position.

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E. The resilient valve seat shall be synthetic rubber designed to seat against a pressure differential of 150 psi on either side of the valve, unless otherwise indicated. The resilient seat shall be mechanically attached to the valve disc or valve body. For valves 24 inches

in diameter and smaller, a vulcanized or bonded seat is acceptable. Any required seat attachment hardware shall be stainless steel. The resilient seat shall be capable of being adjusted or replaced in the field without moving the valve disc along the shaft axis or removing the valve from the line. The mating seat surface shall be stainless steel or monel.

1. The seats shall be factory tested as per AWWA C504 at a test pressure of 150 psig, unless otherwise indicated, and post adjusted for differential pressures indicated herein.

F. Valve shafts shall be one-piece or two-piece units of stainless steel construction suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve disc by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e., mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.

G. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be of stainless steel construction.

H. The shaft seal shall be either the bronze cartridge type with at least two O-rings, monolithic V-Type, U-Cup Type, or pull down packing type. If monolithic V-Type, U-Cup Type, or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered. Stuffing box bolts, studs and nuts shall be stainless steel.

I. The "O" ring type shaft seal shall be contained in a removable bronze cartridge. The bronze cartridge shall be manufactured from ASTM B505 copper alloy UNS #C93200 and shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be nitrile, Buna-N rubber, as intended for use with potable water or wastewater and per ASTM D2000 with a hardness of 70 Shore A Durometer.

J. Manual operators for butterfly valves 18 inches in diameter or larger shall be the worm gear type conforming to AWWA C504. Manual operators for butterfly valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops, shall be sized

according to Table IV for Class 150B, and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule.

K. The manufacturer shall certify that the butterfly valves are capable of operating in continuous duty service under these pressures and flow conditions.

L. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

M. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

## 2.02 HIGH-PERFORMANCE BUTTERFLY VALVE FOR LOW PRESSURE PROCESS AIR (BFV-HP)

A. Isolation valves and throttling valves for low pressure (less than 25 psig) air service shall be resilient-seated butterfly valves as manufactured by Centerline (Crane), Bray, DeZurik or Engineer approved equal. All valve components shall be suitable for continuous operation at temperatures up to 300ºF with a 25-psig minimum working pressure. Materials of construction shall be as specified as follows. Valves shall otherwise be as previously described herein in Article 2.01 – Butterfly Valves (Water Service).

1. Valve Bodies: Type 316 stainless steel

2. Valve Discs and Shafts: Type 316 stainless steel

3. Valve Seals: FKM

B. Valves smaller than 30 inches shall be flanged or have a wafer or lug style body and be compatible with ASME B16.1 flanges. The Contractor shall coordinate flange connections upstream and downstream of wafer valves. Valves 30 inches or larger shall have flanged end connections conforming to ASME B16.1, 125-pound rating.

C. Manually operated isolation valves shall be provided with a handwheel or chainwheel, as required and/or as shown on the drawings, operator and shall provide for tight shut-off. A mechanical dial indicator shall be provided on the operator to continuously indicate valve positions. Where specified and/or as shown on the drawings, the Contractor shall provide motor actuators meeting the requirements of Section 40 05 57 – Valve

Operators and Electric Valve Actuators. Motor actuators for throttling valves shall provide for modulating operation. Cycle time from full open to full closed shall be approximately 60 seconds. 4-20mA position feedback signals shall be provided for each actuator. Contractor shall wire 4-20mA position signals to the PLC.

## 2.03 RECTANGULAR BUTTERFLY VALVE (BFV-R)

A. Rectangular butterfly valves shall be bubble tight with flow in either direction. Rectangular butterfly valves shall be manufactured by Pratt, Hydro Gate, or equal. The Valve body shall be fabricated carbon steel, designed for wall mounting. Valve manufacturer shall provide a double flanged wall thimble to be cast in place. The valve disc shall be fabricated of carbon steel with Type 304 stainless steel seating edge. Disc shall be streamlined in shape to prevent turbulence in fully open position and to minimize pressure drop across valve. The valve seat, contained in the body of the valve, shall be a synthetic rubber compound with a durometer of 50.

B. Seat adjustment shall not be less than 1/8 inch. Valve seat shall be fully field adjustable and replaceable without dismantling operator, disc, or shaft and without the use of special tools. Valve shaft shall be Type 304 stainless steel securely locked to disc by stainless steel taper pins.

C. Each valve assembly shall be furnished with a two-way thrust bearing assembly designed to hold the disc centered in the seat at all times. Thrust bearing shall be secured by locking device and easily accessible for field adjustment from operator end of valve.

D. Valve operators shall conform to AWWA C504 and shall be designed to hold the valve in any intermediate position between fully closed and fully open without creeping or fluttering. Manual operators shall be of the travelling nut, self-locking type and shall be equipped with mechanical stop-limiting devices to prevent overtravel of the disc. Operators shall be fully enclosed and designed to produce the specified torque with a maximum pull of 80 lb. on the handwheel.

E. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

F. The manufacturer shall certify that the rectangular butterfly valves are capable of operating in continuous duty service under the required pressures and flow conditions. Each valve shall be hydrostatically tested and tested for bubble-tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 40 05 65.23
## CHECK VALVES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

### PART 2 – PRODUCTS

### 2.01 SWING CHECK VALVE (CV-S) FOR WATER SERVICE

A. Unless otherwise specified, check valves 3 inches and less shall be bronze, Y-pattern, swing check valves of the regrinding type. Valves shall have a minimum 200 psi non-shock cold water pressure rating and shall be as manufactured by Jenkins Bros. Corp., Crane Company, or equal.

B. Check valves larger than 3 inches shall be cushioned swing check valves rated for a minimum working pressure of 200 psi and shall be of the "Shockless Swing-Check" type as manufactured by G.A. Industries, or equal.

C. Valve closure shall be controlled by an external weighted lever arm, the action of which is cushioned by a hydraulic oil or pneumatic cylinder. Counterweights and cushion cylinders shall be designed so that adjustments can be made in the field to minimize surge and to prevent backflow and hammering noises during actual service conditions. The hydraulic oil or pneumatic cushion system shall be completely self-contained.

D. Valve bodies, cover discs, levers, and disc arms shall be constructed of heavy cast iron or cast steel fully conforming to the latest revision of ASTM A126 Class B or Class WCB, respectively. Valve ends shall be Standard American 125-pound flat-faced flanged, in accordance with ANSI B16.1. Each valve disc shall be suspended from a noncorrosive shaft which shall pass through a stuffing box and be connected on the outside of the valve to the cushion and counterweight mechanism.

E. Valve seating shall be rubber-to-metal designed for drop-tight shutoff. The body seat ring shall be made of bronze or stainless steel and the disc seat ring of 80 Durometer rubber. Body and disc seats shall be renewable.

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F. With the exception of the valve body and seat, all parts in contact with water shall be manufactured from noncorrosive materials. Internal corrosive surfaces shall be shop

painted with two coats of epoxy for corrosion resistance. Exterior surfaces shall be painted in accordance with the requirements of Section 09 90 00 – Painting.

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

# SECTION 40 05 68.13
# PVC AND CPVC VALVES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

## PART 2 – PRODUCTS

### 2.01 MATERIALS OF CONSTRUCTION

A. Valves shall be constructed of materials suitable for the intended service. PVC valves shall be provided in PVC piping and CPVC valves shall be provided in CPVC piping.

B. PVC valve bodies shall be constructed of PVC which shall meet or exceed the requirements of cell classification 12454 according to ASTM D1784. CVPC valve bodies shall be constructed of CPVC which shall meet or exceed the requirements of cell classification 23447 according to ASTM D1784.

C. Materials of construction of other valve components shall be as specified below for the particular type of valve.

D. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

| Non-Chemical Service | Elastomer Material |
|---|---|
| Non-Potable Water | EPDM |
| Process Drain (Gravity), Vent | EPDM, FKM |
| Process Drain (Pressure) | EPDM, FKM |
| Potable Water | EPDM |

E. All flanged valves shall be flat face flanged end type conforming to ANSI B16.5 bolt pattern for 150 lb. flanges.

### 2.02 PVC/CPVC BALL VALVES (BLV-P/BLV-C)

A. Ball valves shall be true union design with flanged, socket, or threaded ends as required and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. All valves shall be full-port design and allow for bi-directional flow. Valve stems shall contain

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double o-ring seals. Valves shall have removable handles and integrally molded mounting features for actuator installation. Ball valves shall be rated for a minimum pressure of 150 psi at 70°F.

B. Valve bodies, stems, balls, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. Ball seats shall be made of PTFE, and o-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Ball valves shall be manufactured by Asahi/America, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

D. Ball valves for sodium hypochlorite service shall be vented, with a single hole factory-drilled into the ball to vent in the upstream direction when the ball is in the closed position. Valves shall be color coded or marked to indicate vented ball design.

E. Where valves are installed in piping to be insulated and jacketed, stem extensions shall be furnished and installed such that the valve can be operated without any interference with these components.

## 2.03 PVC/CPVC SWING CHECK VALVES (CV-PS/CV-CS)

A. Swing check valves shall be single-disc design with pivoting swing arm/disc clapper assembly and flanged ends. Valves shall be full flow, gravity operated, and suitable for either horizontal or vertical applications. Valves shall be capable of top entry to facilitate cleaning and repair without removal from the line. Swing check valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies, bonnets, swing arms, and discs shall be constructed of PVC or CPVC as specified in 2.01 B. O-ring seals and shutters shall be as specified in 2.01 D and 2.01 E.

C. Swing check valves shall be manufactured by Asahi/America, IPEX, Hayward Flow Control, or equal.

## 2.04 PVC/CPVC BALL AND DIAPHRAGM CHECK VALVES (DCV-P/DCV-C)

A. Ball and diaphragm check valves shall be true union design with flanged, socket, or threaded ends as required and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Primary seat shall be square-cut design to ensure proper seating. Valves shall be suitable for either horizontal or vertical applications. Ball and diaphragm check valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies, balls or diaphragms, end connectors, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. O-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Ball and diaphragm check valves shall be manufactured by Asahi/America, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

## 2.05 PVC/CPVC DIAPHRAGM VALVES (DV-P/DV-C)

A. Diaphragm valves shall be weir-type design with multi-turn handwheel for throttling applications. Diaphragm valves shall have flanged, socket, or threaded ends as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Valves shall have a position indicator and adjustable travel stop. Diaphragm valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies, bonnets, end connectors, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. Valve diaphragms and o-rings shall be as specified in 2.01 D and 2.01 E. PVDF vapor barrier shall be provided for PTFE diaphragms.

C. Diaphragm valves shall be manufactured by Asahi/America, IPEX, Hayward Flow Control, Plastomatic, or equal.

## 2.06 PVC/CPVC BUTTERFLY VALVES (BFV-P/BFV-CP)

A. Butterfly valves shall be of flanged design. Valves 6” and smaller shall have lever handles, and larger valve shall have gear operators. Valves shall have the ability to mount actuators. Face seals shall completely isolate the valve body from process flow and function as a flange gasket on both sides of the valve. Butterfly valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies and discs shall be constructed of PVC or CPVC as specified in 2.01 B. Valve shafts shall be made of 316 stainless steel. Valve disc liners and o-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Butterfly valves shall be as manufactured by Asahi/America, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

## 2.07 PVC/CPVC NEEDLE VALVES (NV-P/NV-C)

A. Needle valves shall be provided for accurate flow control applications. Valves shall have integrated stem/seat design and have fine pitch stem threads for precise adjustment. Valve ends shall be flanged, socket, or threaded as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Needle valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies shall be PVC as specified in 2.01 B, seats shall be PFTE, and o-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Needle valves shall be as manufactured by Nibco/Chemtrol, Hayward Flow Control, or equal.

## 2.08 PVC/CPVC GLOBE VALVES (GLV-P/GLV-C)

A. Globe valves shall be provided for flow regulation applications. Valves shall be of union bonnet or outside stem and yolk design. Valve ends shall be flanged, socket, or threaded as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Globe valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies and discs shall be PVC as specified in 2.01 B, and seals shall be as specified in 2.01 D and 2.01 E.

C. Globe valves shall be as manufactured by Asahi/America, or equal.

## 2.09 PVC/CPVC DEGASSING VALVES (DGS-P/DGS-C)

A. Degassing valves shall be provided to continuously vent gases for a liquid-carrying pipeline or vessel. The float-operated valve will open when liquid level falls (indicating the presence of gas) and close when the gas has been evacuated as the liquid level rises. The valve is to automatically vent gas collected over liquid to a pressure of 100 PSI. The specific gravity of the liquid shall not be less than 0.9. Degassing valves shall be installed vertically, at high points in the piping system where gases collect.

B. The Valve body shall be PVC or CPVC. The internal float shall be constructed of Natural Polypropylene. Seals shall be EPDM or Viton, as specified above. There shall be a ½" Female NPT process connection and 1/8" Female NPT vent port.

C. Degassing Valves shall be as manufactured by Plastomatic, or equal.

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

## SECTION 40 05 68.23
## MISCELLANEOUS VALVES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves shall be constructed of materials suitable for the intended service.

### PART 2 – PRODUCTS

### 2.01 GLOBE VALVES

A. Bronze Body (GLV-B)

1. 1/2-Inch to 3-Inch

a. Globe valves for compressed air or water service shall be bronze body and bonnet with brass stem and stainless steel regrindable disc plug. Rising stem and union bonnet through 2-inch and bolted bonnet to 3-inch. Valves shall be Jenkins Valve Fig. 2032J, equivalent by Crane Co., or equal with minimum 300 psi non-shock cold water pressure rating and screwed ends.

### 2.02 SOLENOID VALVES

A. Two-Way (SV-2W)

1. Two-way solenoid valves shall be normally closed and shall open when the solenoid is energized, unless otherwise noted. The valve shall be of forged brass-body and bonnet with a Buna-N diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120V, 60 Hz, single-phase operation. Solenoid enclosure shall be NEMA 4 watertight.

B. Three-Way (SV-3W)

1. Three-way, two-position solenoid valves shall be of the two-coil type. Both coils shall be normally closed and each shall open independently when energized. The valve shall be of forged brass-body and bonnet with a Buna-N diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for

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120V, 60 Hz, single-phase operation. Solenoid enclosure shall be NEMA 4 watertight.

C. Four-Way (SV-4W)

1. Four-way, two-position solenoid valves shall be of the single coil type, shall be normally closed and shall open when the solenoid is energized (i.e., fail closed). The remainder of the four-way, two-position solenoid valves shall be of the two-coil type. Both coils shall be normally closed and each shall open independently when energized. The valve shall be of forged brass-body and bonnet with a Buna-N diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co. or equal, for 120V, 60 Hz, single-phase operation. Solenoid enclosure shall be NEMA 4 watertight. The solenoid valve shall be provided with a manual override.

## 2.03 BACKFLOW PREVENTION VALVES

A. Double Check Style (BFPV-DC)

1. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be as follows.

a. Backflow preventers for pipe sizes 1/2” to 2” shall be a WATTS LF007 or equal.

b. Backflow preventers for pipe sizes 2 1/2” to 10” shall be a WATTS 709 or equal.

c. Backflow preventers for 12” pipe shall be a WATTS 774 or equal.

B. Reduced Pressure Style (BFPV-RP)

1. Backflow preventer shall be of the size shown on the Drawings and shall be of the reduced pressure principle type in accordance with AWWA C510 and C511, with two independent operating spring-loaded check valves and one spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna-N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the Drawings. Reduced pressure backflow preventer installations shall

include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger, which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS LF009, or equal.

## 2.04 PRESSURE RELIEF, REDUCING AND REGULATING VALVES

A. Pressure Relief Valve (PRV)

1. Pressure relief valves 1 inch and smaller shall have bronze bodies and valves larger than 1 inch shall have cast iron bodies, bronze fitted with grey iron diaphragm base and straight chamber and phosphorus bronze diaphragm. The ratio of the diaphragm area to the seat area shall be adequate to overcome sticking. The seat disc shall be of non-corrodible, non-sticking material capable of withstanding extreme temperatures. Valves shall permit dismantling for repairs and cleaning without being removed from the line. Valves shall conform to the ASME Boiler Construction Code as approved by both UL and the National Board of Boiler Pressure Vessel Inspectors. All valves shall be designed for a minimum working pressure at least equal to the working pressure of the corresponding pipeline and shall have adjustment over a range of at least 20 percent above or below the required setting pressure of the installation.

2. Pressure relief valves (non-potable water service) shall be diaphragm activated, single seat, pilot-operated and shall maintain a constant upstream pressure by relieving excess pressure. The valve shall be normally closed and shall open to maintain the required back pressure when the valve inlet pressure reaches the pilot control set point. The initial pilot control setting shall be 78 psi. The stem shall be stainless steel and shall be guided through the center for 100% of the stem travel. The main valve throttling plug shall be provided with V-port sections to insure precise control at low flow rates. All internal metal parts shall be bronze or stainless steel. The control pilot shall be direct acting, spring loaded, and adjustable with bronze body and stainless steel trim. The diaphragm and seat disc shall be Buna-N. The valve shall be of the angle or globe pattern as shown on the Drawings and shall be fully repairable in the line. The pressure relief valve shall be the Model 50-01 as manufactured by CLA-VAL, or equal.

B. Pressure Regulating Valve (PRGV)

1. Pressure reducing and regulating valves (water service) 1/2-inch and smaller shall be bronze, and valves larger than 1/2 inch shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can

be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range at differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be WATTS model LF25AUB-Z3, Zurn Wilkins model 600XLHTSTSC, or equal.

## 2.05 HOSE BIBB (HB)

A. Hose bibbs shall consist of a ball valve assembly suitable for general utility use. Ball valves shall be full port, Type 304 stainless steel body, American Valve Model M71QTSS or equal. Valves shall have a stainless steel ball and stem and PTFE seats and seals. The piping connection end shall have MIP/NPT threads, and the spigot end shall be Garden Hose Thread (GHT). Valve shall be provided with a vinyl-insulated lever handle and suitable for use in corrosive and general utility service

## 2.06 NEEDLE VALVES (NV)

A. Needle valves shall be bronze body and spindle with follower gland and shall be 400 psi, non-shock cold water needle valves, Figure 743-G as manufactured by Jenkins Bros., Corp., Crane Co. No. 88, or equal.

B. Needle valves (service air) shall be bronze body, with stainless steel stem. Valves shall be Jenkins Valve Fig. 741G, Crane Co. or equal and shall have minimum 400 psi non-shock cold water pressure rating and screwed ends.

## 2.07 SURGE RELIEF VALVES (SRV)

A. Surge relief valves shall be wye pattern with a cast iron valve body conforming to ASTM A126 Class B and integral flanges, faced and drilled per ANSI B16.1 Class 125. The valve body shall be inherently self-cleaning and have a net flow area through the valve no less than the area of its nominal pipe size. The body shall have a removable 316 stainless steel seat.

B. The valve disc shall be ductile iron with a renewable, resilient seat ring of rubber or other suitable material and be retained by a 316 stainless steel follower ring and stainless steel screws. The valve stem shall be stainless steel and be guided by a bronze bushing retained in the valve cover. Dual seals shall seal the valve stem where it passes through the body, separated by a lantern ring with external leak detection port.

C. The valve shall have dual compression springs encased in steel cylinders; exposed springs or tension springs are not acceptable. An integral hydraulic system shall permit quick opening and adjustable, slow closing without the need of pre-charged cylinders. The valve shall be fully capable of operating in any position.

D. The valve shall be factory tested and set to open at a pre-determined pressure. Springs shall permit field adjustment from near zero to 10 percent above factory setting.

E. The valve shall quickly open when the system pressure exceeds its setting, remain open whenever the pressure exceeds this setting, and slowly close drop tight when the pressure subsides below the spring setting.

**END OF SECTION**

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## SECTION 40 05 78

## AIR VALVES FOR WATER AND WASTEWATER SERVICE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. The Contractor shall furnish and install, complete with all assemblies and accessories, all air valves shown on the Drawings and specified herein including all fittings, appurtenances, drain connections, and transition pieces required for a complete and operable installation.

C. All valves shall be constructed of materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Valves shall conform to pertinent sections of the latest edition of their respective governing AWWA standards, except as may be modified to comply with pressure ratings specified herein.

D. Valves intended for chemical service shall be constructed of materials suitable for the intended use.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:

1. ANSI/AWWA C512 – Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service

2. All products in contact with potable water shall be certified per NSF-61, NSF-372, and NSF-600.

B. Reference Section 46 00 00 – Equipment General Provisions for additional requirements.

### 1.03 SUBMITTALS

A. The following shall be submitted in compliance with Section 01 33 00 – Submittal Procedures:

1. Affidavit of Compliance for each valve type indicating the valve complies with the latest edition of its governing AWWA standard

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2. All catalog data information, installation drawings, specifications, layout dimensions, size and materials of construction for all components, pressure ratings, support and anchoring, complete descriptive literature to demonstrate full compliance, and manufacturer's certification that products comply with the indicated requirements

3. Operation and Maintenance (O&M) manuals and installation instructions for all valves. O&M manuals shall not include information and/or details which do not apply to the equipment being furnished. O&M manuals shall include:

    a. Manufacturer's catalog data

    b. Manufacturer's installation and operations instructions

    c. Manufacturer's maintenance procedures

    d. List of special tools

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

B. Air valves shall be provided with appropriate materials to provide drip tight closure.

C. Valves 2 inches and smaller shall have NPT threaded inlets and outlets.

D. Valves shall permit dismantling for repairs and cleaning without being removed from the line. All air valves with connections 3 inches and smaller shall include a ball valve of the same diameter as the nominal valve size located on the inlet side for isolation, unless otherwise detailed or noted on the Drawings. Ball valves shall be stainless steel and provided in accordance with 40 05 63 – Ball Valves.

E. Unless otherwise directed by the Owner, isolation valves shall open counterclockwise.

F. The exhaust from the valve shall be piped to a suitable disposal point, with the piping firmly supported and installed in such a way as to avoid splashing and wetting of floors. Exhaust piping shall be no smaller than the diameter of the air valve's largest orifice.

G. For valves where insect screens are required, confirm that the open surface area between the insect screen mesh is no less than the area of the largest air valve orifice so as not to restrict air flow.

H. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with

two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

I. One spare valve shall be provided for each size and type of valve specified.

## 2.02 AIR VALVES FOR WATER SERVICE

A. The valves specified in this section shall be specifically designed for water service.

B. All air valves for water service 1-inch in diameter and larger shall have a ¼-inch minimum diameter drain plug.

C. Air Release Valves (ARV): ARVs for water service shall be designed to operate (open) while pressurized allowing entrained air in a water pipeline to escape through the air release orifice. After entrained air escapes through the air release orifice, the valve orifice shall close tightly. The air release orifice will then remain closed until more air accumulates and the opening cycle repeats automatically.

D. Air/Vacuum Valves (AVV): AVVs for water service shall automatically allow large volumes of air to be released through a large orifice during pipe filling and automatically allow large volumes of air to enter through a large orifice during pipe draining. AVVs shall be designed to react immediately to open when the absolute pressure in the pipeline falls below atmospheric pressure by opening a large orifice.

E. Combination Air Release and Air/Vacuum Valves (CARV): CARVs for water service shall provide the same function as both ARVs and AVVs listed above. CARVs may be a single body housing specifically designed for use with water mains.

F. Sealing pressure shall be listed in the Valve Parameters Table as follows.

G. Acceptable manufacturers for non-surge air valve applications: Crispin, Golden Anderson, Cla-Val, Valmatic, or equal.

1. Materials of Construction

| Component | Material |
|---|---|
| Body, Cover | Cast Iron ASTM A126 Class B or<br>Ductile Iron ASTM A536 Grade 65-45-12 |
| Float | 316 Stainless Steel |
| Seat | FKM, Buna-N, or PVC ASTM 1784 |
| Trim | 304 or 316 Stainless Steel |
| O-rings | FKM or EPDM |
| Connection (2” or smaller) | NPT Threaded |

H. Valve Parameters

| Line Designation and Location | Quantity | Type | Size | Anti-Surge Orifice Size | Normal Operating Pressure(s) (psig)[1] | Air Release Valve Venting Rate (scfm) | Discharge Capacity @ ∆2 psi (scfm) | Intake Capacity @ ∆-5 psi (scfm) |
|---|---|---|---|---|---|---|---|---|
| FE, Final Effluent Water Pump Station | 3 | CARV | 1” | N/A | 90 | 1.3 | 100 | 100 |

NOTES: 1) The listed minimum operating pressure is the sealing pressure required to prevent air valve leakage.

## PART 3 – EXECUTION

### 3.01 TESTING

A. Testing shall be performed in accordance with the latest revision of AWWA C512.

B. Minimum Test Pressure: Air valves for water and wastewater service shall be tested at 20 psig or the minimum operating pressure, whichever is lower.

C. Maximum Test Pressure: Air valves for water and wastewater service shall be tested at 150% of the maximum design pressure.

D. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned.

### 3.02 SHIPMENT

A. Valves shall be complete in all details when shipped. Cavities shall be drained of water to protect from freezing. The openings shall be covered to prevent entry of foreign material, and the threads shall be protected. The manufacturer shall carefully prepare the valves for shipment. Valves shall be fully packaged or attached to pallets at the manufacturer’s option.

### 3.03 INSTALLATION

A. Install all air valves in accordance with the manufacturer’s recommendations.

**END OF SECTION**

## SECTION 40 05 81
## FIRE, WALL AND YARD HYDRANTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

### PART 2 – PRODUCTS

### 2.01 FIRE HYDRANTS

A. All fire hydrants shall be hub end, triple nozzle, approved AWWA type with two (2) 2-1/2-inch hose nozzles and one (1) 4-1/2-inch steamer nozzle with American National Standard hose threads and have a 6-inch bottom mechanical connection.

B. Hydrants shall have a 5-1/4-inch valve opening and shall be built in accordance with AWWA C502. Hydrants shall open left and have a National Standard Pentagon type operating nut (1-1/2-inch point to flat). Hydrants shall have a safety flange and a safety coupling on the valve stem. All hydrants shall be the Mueller Centurion #A-423, or American-Darling #B-62-B with 4'-0" bury depth.

### 2.02 FIRE HYDRANTS

A. Fire hydrants shall be built in accordance with AWWA C502 and shall have integral 5” Storz pumper nozzle connection and two (2) 2 ½-inch hose nozzles with Higbee Cut National Standard threads, and a 1 ½” pentagonal operating nut. Hydrant to open left. The Storz nozzle is to be of one-piece design, an integral part of the fire hydrant and must be furnished by the hydrant manufacturer or authorized distributor. Adapters will not be accepted.

B. Fire hydrants shall be American Darling Mark-73, McWane Ductile/Clow F-2545 Medallion, M&H Style 129, Mueller A 423 Super Centurion 250, or equal.

C. All fire hydrants are to be painted with 2 coats of high gloss enamel Federal Safety Red and shall have interior coatings per AWWA C550.

### 2.03 WALL HYDRANTS

A. Wall hydrants shall be of the non-freeze type, cast-bronze construction with wrought stainless steel self-opening, vandal-proof locking cover box, 3/4-inch N.P.T. outlet, integral vacuum breaker backflow preventer, pressure relief valve, bronze casing, bronze operating parts convertible into service tool, "T" handle key. 3/4-inch female and

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1-inch male N.P.T. inlet connection. The wall hydrant shall be Models 7.500 as manufactured by Josam, Z-1305 as manufactured by Zurn, 5509 as manufactured by Smith Company, or equal.

## 2.04 YARD HYDRANTS

A. Service water system hydrants shall be of the 2 inch non freeze, self-draining, post yard type. Operating parts must be removable through the top of the hydrant.

B. The inlet shall be 4” mechanical joint and outlet shall be 1 ½” NST. Hydrants shall have ductile iron casing pipe, stainless steel operating rod and cast-iron top stock. Each hydrant shall be equipped with suitable removable adapters to connect 1 ½-inch and ¾-inch hoses.

C. Each hydrant shall be supplied with a 10-inch operating hand wheel.

D. Hydrants shall be Eclipse Model 2 by Kupferle or approved equal.

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

## SECTION 40 05 89.13
## BASKET STRAINERS FOR PROCESS SERVICE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and test duplex manual basket strainers capable of removing unwanted fines and debris from service water.

B. The equipment shall be offered complete with all accessories, spare parts, mountings, and other appurtenances as shown on the Drawings and as specified herein.

### 1.02 RELATED SECTIONS

A. Division 01 – General Requirements

B. Division 40 – Process Interconnections

C. Section 46 00 00 – Equipment General Provisions

### 1.03 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in, Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Product Data

    a. Manufacturer’s literature, illustrations, specifications and engineering data

    b. Capacities, performance characteristics, and certified pressure drop curve

    c. Materials of construction

    d. Manufacturer’s installation instructions

    e. Equipment weight and total shipping weight

    f. Painting/coatings data

2. Shop Drawings

    a. Complete detailed equipment assemblies indicating dimensions, weights, required clearances, method of field assembly, components, nameplate(s), and location and size of each connection

3. O&M Manuals

4. Spare Parts List including part numbers and quantities

5. Field and Shop Test Reports

## 1.04 WARRANTY

A. Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

# PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

A. Strainer shall be manufactured by:

1. Eaton

2. Mueller

3. Or equal

## 2.02 DESIGN CRITERIA

A. The strainers shall meet the following criteria:

| Parameter | Value |
|---|---|
| Location | Thermal Dryer Facility Dryer Room |
| Quantity | 1 |
| Service | Final Effluent (Cooling Water Supply) |
| Configuration | Duplex |
| Minimum Flow Rate (gpm) | 400 |
| Maximum Flow Rate (gpm) | 475 |
| Inlet/Outlet Diameter (inches) | 6 |
| Maximum Strainer Basket Opening (inches) | 1/16 |
| Maximum Clean Pressure Drop (psi) | 2 |

## 2.03 CONSTRUCTION

A. Manually cleaned strainer shall be the duplex basket tapered plug type.

B. Strainer shall have flanged ends conforming to ANSI B16.1125/150-pound standard.

C. Strainer shall be constructed with an ASTM A48, Class 30 cast iron body with ductile iron trim and shall have removable, staggered hole perforation, Type 304 stainless steel filter baskets.

D. Strainer shall be suitable for 125 psi service.

E. Switching flow from one basket to the other shall be accomplished by moving the handle through a 180-degree arc. The switching operation shall not stop flow through the strainer and shall provide for on-line removal of either basket with the other basket functional. The plug shall be automatically positioned with integral stops and shall be easily lifted and reseated under pressure.

F. The strainer shall be designed to minimize the possibility of material bypassing the plug while being rotated and to prevent debris from building up under the plug. The strainer covers shall be designed for quick opening with swing away yoke.

G. Each basket compartment shall have a side drain outlet.

H. O-rings shall be Buna-N.

I. All strainers shall be provided with support legs.

J. Isolation valves shall be provided as shown on the Drawings.

## 2.04 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and include the following:

1. One strainer basket

2. One complete set of gaskets

3. Spare parts recommended by the equipment manufacturer for 2 years of normal equipment operation (excluding spare parts previously listed)

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Strainer equipment and appurtenances shall be installed in accordance with manufacturer’s installation instructions, Drawings, and as specified herein.

## 3.02 CLEANING

A. Prior to acceptance of the work of this section, thoroughly clean all installed materials, equipment, and related areas in accordance with the requirements of Division 01 – General Requirements.

## 3.03 FIELD TESTING

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 1 |
| Startup and Training | 1 | 1 |

**END OF SECTION**

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## SECTION 40 05 97
## PIPING AND EQUIPMENT IDENTIFICATION SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all components of the system for identification of piping and equipment as specified hereinafter. The system shall include the application of color coding to all new and altered plant piping. The Contractor shall paint the equipment and piping in the colors herein specified, and in accordance with the requirements of Section 09 90 00 – Painting.

B. In addition to the legends specified herein, the Engineer may order the Contractor to furnish and install additional identification legends and arrows at no additional cost to the Owner. Such additional signs may be requested near completion of the work and shall be limited to no more than five signs for each type specified herein. The legends and color combinations for additional signs shall conform to the requirements specified herein.

C. The Contractor shall submit a schedule of the colors and designations proposed in accordance with Section 01 33 00 – Submittal Procedures and this Section. A minimum of four color charts with cross-references to the colors listed herein shall be included with the Submittal.

D. Reference Section 40 05 00 – Basic Mechanical Requirements.

### PART 2 – PRODUCTS

### 2.01 PIPING BAND

A. All new and altered piping shall receive identification bands. Such bands shall be 6 inches wide, neatly made by masking, and spaced at intervals of 30 inches on center regardless of the diameter of the pipe being painted. The Contractor may use approved precut and prefinished metal bands on piping, in lieu of the masked and painted bands, where approved by the Engineer.

### 2.02 PIPING IDENTIFICATION LEGEND

A. The Contractor shall apply identification legends to all types and sections of piping as shown on the Drawings or as designated by the Engineer. Such legends shall be in the form of plain block lettering giving the name of the pipe content in full or abbreviated form and showing the direction of flow by arrows. All lettering and arrows shall be of the plastic snap-on type, Seton nameplate "setmarks", or equal, or they shall be formed by

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stenciling in an approved manner using white or black as directed and shall have an overall height in inches in accordance with the following table:

| Diameter of Pipe or Pipe Covering (inches) | Height of Lettering (inches) |
|---|---|
| 3/4 to 1-1/4 | 1/2 |
| 1-1/2 to 2 | 3/4 |
| 2-1/2 to 6 | 1-1/4 |
| 8 to 10 | 2-1/2 |
| Over 10 | 3-1/2 |

B. Identification lettering shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each 15 feet in pipe length, and shall be properly inclined to the pipe axis to facilitate easy reading. In the event lettering and arrow identifications are required for piping less than 3/4 inch in diameter, the Contractor shall furnish and attach approved color-coded tags where instructed.

C. The colors referenced in the legend are as manufactured by KOP-COAT. They are used for convenience only. Colors shall match existing piping.

D. Piping and Equipment Identification

| Service | Legend | Color |
|---|---|---|
| Compressed Air | CA | Dark Green |
| Dewatered Sludge Cake | DWS | Dark Brown |
| Final Effluent Water | FE | Light Green |
| Natural Gas | NG | Yellow |
| Nitrogen | N | Green with Blue Band |
| Non-Potable Water | NPW | Purple |
| Potable Cold Water | PW | Blue |
| Potable Hot Water | PW-Hot | Blue |
| Sanitary Sewer and Process Drains | SS or D | Green |
| Storm Drain | SD | Brown |
| Thermal Fluid Supply and Return | TFS or TFR | Yellow with Black Band |

| Service | Legend | Color |
|---|---|---|
| Vent | V | Black |

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

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## SECTION 40 06 20

## PROCESS PIPE, VALVE, AND GATE SCHEDULES

### PART 1 - GENERAL

### 1.01 THE REQUIREMENT

A. Reference Section 40 05 00 - Basic Mechanical Requirements.

### 1.02 PIPING SCHEDULES

A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.

B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

| PIPE SIZE | MATERIAL | TYPE OF JOINT | CLASS/DESIGN | TEST PRESSURE |
|---|---|---|---|---|
| 4-IN AND LARGER | DIP | FLANGED (EXPOSED) | CLASS 53 | (1) |
| | | RESTRAINED (BURIED) | PRESSURE CLASS 350 | |
| LESS THAN 4-IN | PVC/CPVC (2) | SOCKET | SCH 80 | (1) |

(1) Test at 150 percent of working pressure or 10 psi, whichever is greater.
(2) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used.

### 1.03 VALVE SCHEDULES

A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.

B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

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### 1.04 GATE SCHEDULES

A. Gates shall be tagged by the manufacturer according to locations listed in this Section.

## WATER POLLUTION CONTROL PLANT PIPING SCHEDULE

| PIPE DESIGNATIONS | | MATERIAL | BURIED PIPING | | EXPOSED PIPING | | | DESIGN PRESSURE (PSI)[1] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TYPE OF JOINT | CLASS/ DESIGN | TYPE OF JOINT | CLASS/ DESIGN | HEAT TRACE[2] | WORKING | SURGE | RESTRAINT | FIELD TEST |
| CA | COMPRESSED AIR | STAINLESS STEEL | THREADED/ PROPRESS | SECTION 40 05 24.43 | SOCKET WELD/ THREADED | SECTION 40 05 24.43 | NO | 130 | N/A | N/A | 195 |
| DWS | DEWATERED SLUDGE CAKE | TYPE 304 STAINLESS STEEL | N/A | N/A | WELDED/ GROOVED/ FLANGED[4] | SECTION 40 05 24.23 | NO | PIPE SYSTEM DESIGN BY DRYER SYSTEM SUPPLIER | | | |
| FA | FOUL AIR | PVC / CPVC[3] | N/A | N/A | SOCKET/ FLANGED | SCH 80 | NO | PIPE SYSTEM DESIGN BY DRYER SYSTEM SUPPLIER | | | |
| FE | FINAL EFFLUENT | DIP | RESTRAINED | PRESSURE CLASS 150 | FLANGED | CLASS 53 | NO | 90 | 115 | 150 | 135 |
| N | NITROGEN | STEEL | N/A | N/A | SOCKET WELD/ THREADED | SECTION 40 05 24.43 | NO | 80 | N/A | 140 | 120 |
| PDG | PROCESS DRAIN GRAVITY | < 4" PVC / CPVC[3] | BELL & SPIGOT | SDR 35 (PSM) | SOCKET/ FLANGED | SCH 80 | NO | N/A | N/A | N/A | 5 |
| | | > = 4" DIP | RESTRAINED | PRESSURE CLASS 150 | FLANGED | CLASS 53 | NO | | | | |
| SD | STORM DRAIN | RCP | PUSH-ON | CLASS III | N/A | N/A | N/A | SECTION 33 24 00 | | | |
| SS | SANITARY SEWER GRAVITY | PVC | BELL & SPIGOT | SDR 35 (PSM) | N/A | N/A | N/A | N/A | N/A | N/A | 9 |
| TFS | THERMAL FLUID SUPPLY | CARBON STEEL | N/A | N/A | WELDED/ FLANGED[4] | PIPE SYSTEM DESIGN BY DRYER SYSTEM SUPPLIER | | | | | |
| TFR | THERMAL FLUID RETURN | CARBON STEEL | N/A | N/A | WELDED/ FLANGED[4] | PIPE SYSTEM DESIGN BY DRYER SYSTEM SUPPLIER | | | | | |
| V | VENT | < 4" PVC / CPVC[3] | SOCKET | SCH 80 | SOCKET/ FLANGED | SCH 80 | N/A | N/A | N/A | N/A | 9 |

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.
2) Provide heat tracing and insulation on all exposed outdoor piping indicated.
3) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used.
4) Flanges shall be provided as shown on the Drawings or as approved by the Engineer.
5) Flanged by grooved adapters shall be used at transitions to equipment or valves that are specified to be flanged.

## ELECTRICALLY OPERATED VALVE SCHEDULE

| TAG No. | VALVE TYPE | OPERATOR TYPE | SIZE (inches) | FLOW | MAX DIFFERENTIAL PRESSURE (psi) | CLASS | SERVICE | LOCATION |
|---|---|---|---|---|---|---|---|---|
| MOV26104 | KNIFE GATE | OPEN/CLOSE | 12 | 25 GPM | 300 | 150 | DWS | DEWATERED CAKE FEED PUMP 1 DISCHARGE |
| MOV26114 | KNIFE GATE | OPEN/CLOSE | 12 | 25 GPM | 300 | 150 | DWS | DEWATERED CAKE FEED PUMP 2 DISCHARGE |
| MOV26502 | BALL | OPEN/CLOSE | 1/2 | 10 GPM | 60 | 150 | FE | DRYER EMERGENCY SPRAY SUPPLY |
| MOV26801 | BALL | OPEN/CLOSE | 6 | 315 GPM | 60 | 150 | FE | CONDENSER SUPPLY |
| MOV26901 | BALL | OPEN/CLOSE | 2 | 70 GPM | 60 | 150 | FE | COOLING CONVEYOR SUPPLY |

1) Pulse Control - See Specification Sections 40 05 57 - Valve Operators and Electric Valve Actuators and 40 61 96 - Process Control Descriptions.
2) Provide remote control station as specified in Section 40 05 57 - Valve Operators and Electric Valve Actuators.

## 40 05 59.23 FABRICATED STAINLESS STEEL SLIDE GATE SCHEDULE (ANSI/AWWA C561)

| TAG No. | DESCRIPTION | SIZE | | DESIGN HEAD[1] | | SUBMERGED/ FREE SURFACE | OPEN DIRECTION (UP/DOWN) | GATE MOUNT | GATE CONFIG-URATION | DUAL STEM (YES/NO) | ACTUATOR STAND MOUNT | ACTUATOR TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WIDTH (inches) | HEIGHT (inches) | SEATING (feet) | UN-SEATING (feet) | | | | | | | |
| SLG-27100 | FINAL EFFLUENT WATER PUMP STATION ISOLATION | 12 | 12 | 7.75 | 7.75 | SUBMERGED | UP | CONCRETE (SURFACE) | SELF-CONTAINED | NO | OFFSET PEDESTAL | HAND-CRANK |

1) Design Head is as measured from the gate invert to the maximum WSEL.

## SECTION 40 42 13
## INSULATION

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish and install insulation as shown on the Drawings or otherwise specified. Insulation shall not be installed until piping has been field tested and approved by the Owner. The Contractor shall protect the insulation from moisture at all times.

B. Reference Section 40 05 00 – Basic Mechanical Requirements.

## PART 2 – PRODUCTS

### 2.01 INSULATED PROCESS/CHEMICAL PIPING

A. Fiberglass insulation shall be Owens Corning Fiberglass Corp., Fiberglass 25ASJ/SSC; Certain Teed Products Corporation, Certain Teed snap-on ASJ/SSL; or equal. Insulation shall be heavy density sectional pipe insulation with vapor barrier and self-sealing lap. Minimum density insulation density shall be 6 pounds per cubic foot. Contractor shall use manufacturer's recommended adhesives and tape for jointing material. Fittings shall be molded fiberglass. Minimum insulation thickness shall be 1-1/2 inches for 4-inch-diameter pipe and larger, and 1 inch for smaller pipe. Insulation thickness for heat traced pipe shall be as directed by Engineer.

B. Weatherproof insulation jacket for process piping shall be Certain Teed Products Corporation; Childers Products Company, Lock On and Slip On; or equal. Jacket shall be smooth embossed aluminum metal jacket with minimum thickness 0.016 inch thick for interior installations and at least 0.031 inch thick for exterior installations. Fastening shall use preformed "Z"-lock seam with 2-inch butt strap with sealant. Bonds shall be 1/2-inch aluminum with wing seals. Fittings shall be prefabricated 0.016/0.031-inch-thick aluminum.

1. Contractor shall install weather proofing for outdoor piping. The field applied jacket with moisture barrier shall be slipped around pipe into preformed Z-lock position. Butt next jacket section adjacent to previous section leaving 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. Contractor shall install preformed fittings identical in composition to pipe jacketing at all fittings.

C. Insulation fitting covers and jacket for chemical piping shall be Zeston 2000 PVC by Manville, or equal. Fitting covers shall fit snugly over fittings, including all elbows and

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valves, etc. Jacketing shall be high-impact UV-resistant covering for insulated piping and shall match fitting covers. Fitting covers and jackets shall be white and suitable for painting. PVC jacketing shall be 30 mils thick and shall be factory curled to fit snugly. Fitting covers and jacketing shall be secured with tacks.

D. The Contractor shall ensure that surfaces of pipes, valves, heat tracing (if provided), and fittings are clean and dry prior to installation of insulation. Insulation shall be installed so as to make surfaces smooth, even, and substantially flush with the adjacent insulation. The Contractor shall follow the manufacturer's application instructions for the materials used.

## 2.02 INSULATED AIR PIPING

A. Fiberglass insulation shall be provided for exposed exterior blower discharge piping as shown on the Drawings and as specified herein. Insulation shall be a roll of semi-rigid fiberglass board insulation. The fibrous insulation is adhered to the ASJ jacket with the end grain of the insulation perpendicular to the jacket surface. Each section of insulation may be secured on the longitudinal seam by using staples and mastic or vapor barrier ASJ pressure sensitive tape. Adjacent sections shall be butted together and sealed with vapor barrier ASJ tape. The insulation shall be 2-1/2 inches thick with a fiberglass density of at least 3 pounds per cubic foot.

B. Insulation for fittings and flanges shall be mitered segments of nominal 6 pounds per cubic foot density fiberglass pipe covering. Cover with a coat of insulating cement then embed a 20 x 20 weave white glass reinforcing cloth between two 1/16-inch coats of Benjamin Foster 30-36. The glass cloth and second coat shall overlap adjacent covering by two inches. Insulation shall be fiberglass pipe wrap as manufactured by Owens-Corning, Johns Mansfield, or equal.

C. The insulation shall be covered with a smooth, weatherproof, embossed aluminum jacket with integral Kraft-polyethylene vapor barrier separating the insulation from the metal. The factory applied aluminum jackets shall be at least 0.016 inch thick for interior installation and at least 0.031 inch thick for exterior installation. They shall be at least 36 inches long as measured along the pipe.

D. Circumferentially, the width of the sheets shall be 1/2 to 2 inches greater than the circumference of the pipe insulation with a Pittsburgh locktype on the longitudinal edge.

E. The metal jackets shall be held in place by 0.020-inch-thick, 3/4-inch-wide, metal bands on 9-inch centers.

F. Special care shall be taken to make all exterior insulation jackets completely waterproof by the use of an appropriate silicone base sealant at all joints, etc.

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 40 61 13
## PROCESS CONTROL SYSTEM GENERAL PROVISIONS

### PART 1 – GENERAL

### 1.01 SCOPE

A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, components, system installation services, as well as required and specified ancillary services in connection with the Instrumentation, Control and Information System.

B. The System includes materials, labor, tools, fees, charges, and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system.

C. The system shall include measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring, and pertinent accessories.

D. Two subcontractors shall have responsibility for Sections 40 61 13 through 40 79 00, the instrumentation and control system subcontractor and the System Programmer.

1. Instrumentation and Control System Subcontractor

    a. Shall be responsible for providing panels and hardware within the panels, providing field instruments, modifying existing panels, providing field instrument services, providing, documenting and terminating fiber optic cables, documenting existing panels, providing a site for factory acceptance testing, and for providing all materials and services for complete and operable instrumentation and control system which are not specifically identified as being provided by the System Programmer.

    b. Shall be responsible for coordinating I/O terminations, I/O module order, IP addresses, etc., with the System Programmer

2. System Programmer (all work by System Programmer is separate from this construction Contract and will be provided by Control Automation, Inc. (Jim Besselman) and/or Prime Controls under a monthly support agreement with the Owner)

    a. Shall be responsible for programming PLCs which have been furnished by the instrumentation and control system subcontractor (see Article 1.01, Paragraph D, Item 1 herein). Instrumentation and control system

subcontractor described in Article 1.01, Paragraph D, Item 1 is not responsible for programming PLCs provided under the instrumentation and control system subcontractor's scope

b. Shall be responsible for providing HMI software and programming it to monitor and send control inputs to PLCs provided under this Division and other Divisions

c. System Programmer shall be an active participant in factory and field testing.

d. System Programmer shall coordinate IP addresses, PLC registers, tag names, communication protocols, etc., with all suppliers of equipment which are networked to the Plant Control System

E. The scope of the work to be performed under this Division includes but is not limited to the following:

1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.

2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.

3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in Sections Sections 40 61 13 through 40 79 00, inclusive and where included.

4. Furnish and install digital control system hardware and software as specified in Sections 40 61 13 through 40 79 00, inclusive and where included.

5. Final termination and testing of instrumentation and control system signal wiring and power supply wiring at equipment furnished under Sections 40 61 13 through 40 79 00, inclusive and where included.

6. Furnish, install and terminate special cables for devices (e.g., instruments, printers, radios). Furnish and terminate control system communication network cables.

7. Furnish and install surge protection devices for digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 26 – Electrical.

8. Coordinate grounding requirements with the electrical subcontractor for digital equipment, local control panels, remote telemetry units, and instrumentation

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provided under this Division. Terminate grounding system cables at equipment provided under this Division.

9. Provide system testing, calibration, training and startup services as specified herein and as required to make systems fully operational.

F. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

## 1.02 RELATED ITEMS

A. Field mounted switches, torque switches, limit switches, gauges, valve and gate operator position transmitters, sump pump controls, and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested, and calibrated as specified under other Divisions unless otherwise indicated.

B. Additional and related work performed under Division 26 – Electrical includes the following:

1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for equipment, control panels and accessories furnished under Sections 40 60 00 through 40 79 99, inclusive and where included.

2. Conduit and raceways for instrumentation and control system signal wiring, grounding systems, special cables and communication network cables.

3. Instrumentation and control system signal wiring.

4. Install control system communication network cables.

5. Furnish and install grounding systems for digital equipment, local control panels, remote telemetry units, and instrumentation provided under Sections 40 60 00 through 40 79 99, inclusive and where included. Grounding systems shall be complete to the equipment provided under Sections 40 60 00 through 40 79 99, inclusive, and where included, ready for termination by the instrumentation subcontractor.

6. Termination of instrumentation and control system signal wiring at equipment furnished under other Divisions of the Specifications.

7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g., panelboards, motor control centers, and other sources of electrical power).

## 1.03 GENERAL INFORMATION AND DESCRIPTION

A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

B. In order to centralize responsibility, it is required that equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating signals, and furnishing appurtenant equipment.

C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment/systems and shall provide for the services of a qualified installation engineer to supervise activities required to place the completed facility in stable operation under full digital control.

D. The instrumentation and control system shall be capable of simultaneously implementing all real time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of other system components.

E. Control system inputs and outputs are listed in Section 40 61 93 – Process Control System Input/Output List. This information, together with the functional control descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real time monitoring and control functions to be performed. In addition, the system shall provide various human/machine interface and data reporting functions as specified in the software sections of this Specification.

F. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect equipment, panels, instrumentation, controls, and appurtenances, either existing or furnished on the Project to determine requirements for interfacing with the control and information system. The Contractor shall coordinate the completion of required modifications with the associated supplier of the item furnished.

G. The instrumentation subcontractor shall review and approve the size and routing of instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.

H. The Contractor shall coordinate the efforts of each supplier to aid in interfacing systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.

I. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.

J. The Owner shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to observe materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records, and certifications during all stages of design, fabrication, and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies, and services required for these observation activities.

K. The terms "Instrumentation," "Instrumentation and Control System," and "Instrumentation, Control and Information System" shall hereinafter be defined as equipment, labor, services, and documents necessary to meet the intent of the Specifications.

## 1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment facilities, remote telemetry systems for water supply/distribution systems, and remote telemetry systems for wastewater collection systems. Instrumentation and control system subcontractors shall have a minimum of five years of such experience and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers/models of major hardware or software products (PLC, HMI software, network, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least one project using that specified hardware or software. As used herein, the term “completed” shall mean that a project has been brought to final completion and final payment has been made.

B. Acceptable instrumentation and control system subcontractors shall be:

1. Inframark, LLC

2. Revere Control Systems

3. Global Controls

4. Control Instruments, Inc. (C2i)

5. Southern Flow

## 1.05 DEFINITIONS

A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.

B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.

D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (MTBF / (MTBF + MTTR)) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A2 + 1 - ((1 - A1) * (1 - A1))$$

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

1. A - Availability
2. ADC - Analog to Digital Converter
3. AI - Analog Input
4. AO - Analog Output
5. AVAIL - Available
6. BCD - Binary Coded Decimal
7. CSMA/CD - Carrier Sense Multiple Access/Collision Detect
8. CPU - Central Processing Unit
9. CRC - Cyclic Redundancy Check
10. CS - Control Strategy
11. DAC - Digital to Analog Converter
12. DBMS - Data Base Management System
13. DI - Discrete Input
14. DMA - Direct Memory Access
15. DO - Discrete Output
16. DPDT - Double Pole, Double Throw
17. DVE - Digital to Video Electronics
18. EPROM - Erasable, Programmable Read Only Memory
19. FDM - Frequency Division Multiplexing
20. FSK - Frequency Shift Keyed
21. HMI - Human Machine Interface (Software)
22. I/O - Input/Output
23. LAN - Network and Communication Equipment
24. LCD - Liquid Crystal Display

25. LDFW - Lead Follow
26. MCC - Motor Control Center
27. MTBF - Mean Time Between Failures
28. MTTR - Mean Time to Repair
29. OS - Operating System
30. PAC - Programmable Automation Controller
31. PCB - Printed Circuit Board
32. PID - Proportional Integral and Derivative Control
33. PLC - Programmable Logic Controller or Programmable Controller
34. PROM - Programmable Read Only Memory
35. RAM - Random Access Memory
36. RDY - Ready
37. RMSS - Root Mean Square Summation
38. RNG - Running
39. ROM - Read Only Memory
40. RTU - Remote Telemetry Unit
41. SPDT - Single Pole, Double Throw
42. ST/SP - Start/Stop
43. TDM - Time Division Multiplexing
44. UPS - Uninterruptible Power Supply
45. VFD - Variable Frequency Drive

H. To minimize the number of characters in words used in textual descriptions on displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

## 1.06 ENVIRONMENTAL CONDITIONS

A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.

B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (e.g., dust).

C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.

D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

# PART 2 – PRODUCTS (NOT USED)

# PART 3 – EXECUTION

## 3.01 SCHEDULE OF PAYMENT

A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer payment for the Control and Information System.

B. The following payment schedule defines project milestones that will be used for establishing maximum partial payment amounts for the Control and Information System. Payment for field instruments, field wiring, fiber optic network cable and similar items will be made in addition to the payment for the scopes of services incorporated into the schedule below.

1. Task Completed: Maximum Cumulative % Request for Payment

    a. Mobilization: 3%

    b. Preliminary Design Review: 5%

c. Approved Submittals: 20%

d. Hardware Purchase (excludes field instruments): 40%

e. Factory Witness Test: 60%

f. Loop Checkout: 70%

g. Control System Start-up and Test: 80%

h. Plant Startup: 90%

i. Final System Acceptance Test: 95%

j. Final Acceptance: 100%

C. Requests for payment for materials and equipment that are not installed on site but are required for system construction and the factory witness test (e.g., digital hardware), or are properly stored as described in the General and Supplementary Conditions and herein, shall be accompanied by invoices from the original supplier to the instrumentation subcontractor substantiating the cost of the materials or equipment.

D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials for which payment is made by invoice, will be considered due upon completion of the Final Acceptance test.

## 3.02 CLEANING

A. The Contractor shall thoroughly clean soiled surfaces of installed equipment and materials.

B. Upon completion of the instrumentation and control work, the Contractor shall remove surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

## 3.03 FINAL ACCEPTANCE

A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:

1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.

2. Completion of the Availability Demonstration.

3. Completion of control system training requirements.

4. Completion of punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the warranty period.

**END OF SECTION**

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## SECTION 40 61 15
## PROCESS CONTROL SYSTEM SUBMITTALS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General Conditions, Supplemental Conditions and Division 01 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

B. All submittal materials shall be tailored to this project by highlighting relevant items or crossing out non-applicable items. Generic submittals without identified options will be returned the Contractor without review.

C. Compliance, Deviations, and Exceptions (CD&E) Letter

1. Where a named manufacturer/product or manufacturer is specified and a substitution or an “or equal” product is submitted, the submittal shall be accompanied by a “Compliance, Deviations, and Exceptions (CD&E) letter.” If the required submittal is submitted without the letter, the submittal will be rejected.

2. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor, subcontractor (if applicable), and the equipment Manufacturer/Supplier. This letter shall include a copy of the Specification Section to which the submittal pertains. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in.

   a. The letter "C" shall be for full compliance with the requirement.

   b. The letter "D" shall be for a deviation from the requirement.

   c. The letter "E" shall be for taking exception to a requirement.

3. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions shall not be acceptable.

4. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

D. Although this Section is intended to list the majority of submittals required for this Project, there may be additional submittal requirements in other Sections. Reference the

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applicable Sections for a given topic and include additional submittal information when required.

## 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

## 1.03 EXISTING CONDITIONS / AS-BUILT DOCUMENTATION SUBMITTAL

A. Prior to modifying, demolishing, removing, or decommissioning equipment, thoroughly investigate and document the existing conditions. Please note that Owner's record drawings alone are not sufficient for documentation. The record drawings, if present, shall be verified in the field prior to submitting. Submit drawings, markup, sketches, information, or other materials for documenting the following existing conditions:

   1. All I/O on PLC modules that have its wiring modified or new I/O terminated or for any PLC that is being decommissioned/removed/demolished. Document module number, point number, wire numbers, terminal numbers, destination, function, and whether the connected device is functioning.

   2. All wiring entering or leaving an enclosure that is being decommissioned, removed, or demolished that is not otherwise accounted for.

   3. Documentation of configuration settings, logic, or other customizable parameters. For PLCs, OITs, and similar, a download of its logic or application file is acceptable.

B. When all information has been gathered, it shall be submitted to Engineer along with a clear and unequivocal statement that the existing conditions have been documented and understood. Contractor shall be held responsible for all issues that arise due to Contractor's modifications, demolition, removal, or decommissioning of existing equipment, including necessary reversion back to previous conditions.

## 1.04 DIGITAL HARDWARE SUBMITTALS

A. Submit system block diagram(s) showing:

   1. All equipment to be provided

   2. All interconnecting cable

   3. Equipment names, manufacturer, and model numbers

   4. Equipment locations

B. Submit information for all digital equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations

2. Catalog cuts, including complete part number breakdown information

3. Complete technical, material and environmental specifications

4. Assembly drawings

5. Mounting requirements

6. Color samples

7. Nameplates

8. Environmental requirements during storage and operation

## 1.05 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. Bill of materials with software names, vendors, and complete listings of included software modules

2. Standard manufacturer's literature describing the products

3. Description of function of software in Control and Information System

4. Limitations or constraints of software

5. Minimum system (processor and memory) requirements

6. Operation and maintenance requirements

B. Submit information on the following software:

1. Third-party software, including:

a. Operating system

b. Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.)

c. Office-type products, such as spreadsheets, word processors, etc.

d. Database management software

e. Communication software, including all applicable local and wide area network software

f. Programmable controller programming software (where applicable)

2. Software configuration, including:

a. Graphic display organization

b. Database configuration for operator workstations and database management system

c. Trends

d. System security

e. Formats for all reports, including all required calculations

f. Intercommunications between software products required to implement system functions.

g. Equipment backup configuration and requirements

C. Control Strategies

1. Description of automatic logic and all non-standard manual logic using plain English, for non-technical persons, and written in Contractor's own words. The write-up shall include references to associated I/O, tag/loop numbers, alarming/interlocks.

2. Submitting language verbatim to Section 40 61 96 – Process Control Descriptions shall not be acceptable.

D. Application Software

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include any add-in custom software.

E. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein. Submitted graphic displays shall be for both new and modified graphics.

2. Submit the complete set of graphic displays for review by the Owner and the Engineer at least 60 days prior to commencement of factory testing.

3. Where a large number of graphic displays are required, submit an initial set of example displays for review before the complete set of displays is submitted. This initial set shall include examples of all basic graphic display design features and parameters and is intended to allow the Contractor to obtain preliminary approval of these features and parameters prior to beginning main graphic display production.

4. The Contractor shall allow for one major cycle of revisions to the displays prior to factory testing and one minor cycle of revisions following factory test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer and the Owner. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.

5. The required submittals in each revision cycle shall be full color prints of the entire set of displays.

6. Displays shall be printouts of actual process graphics implemented in the system.

7. See additional requirements in Section 40 68 00.13 – Process Control Software (Modify).

## 1.06 CONTROL PANEL SUBMITTALS

A. Submittals shall be provided for all control panels, and shall include:

1. Exterior panel drawings with front and side views, to scale

2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale

3. Panel area reserved for cable access and conduit entry

4. Location plans showing each panel in its assigned location

5. Thermal (heating and cooling) calculations

6. Power calculations, including UPS sizing and runtime calculation, if provided

7. Proof of over current protective device selective coordination, if requested

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations

2. Catalog cuts, including complete part number breakdown information

3. Complete technical, material and environmental specifications

4. Assembly drawings

5. Mounting requirements

6. Material and color samples, where required

7. Nameplates

8. Environmental requirements during storage and operation

C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc. Include remote equipment labels, remote contact/signal names, remote terminal numbers, and field conduit/cable identification.

**1.07 INSTRUMENT SUBMITTALS**

A. Submit information on all field instruments, including but not limited to the following:

1. Product (item) name and tag number used herein and on the Contract Drawings

2. Catalog cuts, including complete part number breakdown information

3. Manufacturer's complete model number

4. Location of the device

5. Input output characteristics

6. Range, size, and graduations

7. Physical size with dimensions, NEMA enclosure classification, and mounting details

8. Materials of construction of all enclosures, wetted parts and major components

9. Instrument or control device sizing calculations where applicable

10. Certified calibration data on all flow metering devices

11. Environmental requirements during storage and operation

12. Associated surge protection devices

13. Installation drawings/details

14. Material samples, where required

## 1.08 TESTING & START-UP (MULTIPLE SUBMITTALS)

A. Test plans per Section 40 61 21 – Process Control System Testing, unless otherwise indicated.

1. Factory witness testing plan

2. Field testing plan

3. Final acceptance testing plan

4. Instrument test plan per Section 40 70 00 – Instrumentation for Process Systems

5. Blank calibration/verification sheets per Section 40 70 00 – Instrumentation for Process Systems

B. Test results per Section 40 61 21 – Process Control System Testing, unless otherwise indicated

1. Factory witness testing results

2. Field testing results

3. Final acceptance testing results

4. Completed calibration/verification sheets per Section 40 70 00 – Instrumentation for Process Systems

C. Proposed maintenance agreement per Section 40 61 24 – Quality Assurance

## 1.09 WIRING AND LOOP DIAGRAMS

A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.

B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with

equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11- X 17-inch reproducible prints.

C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items.

D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required herein contain all information required by ISA 5.4.

## 1.10 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01 33 00 – Submittals. Operation and Maintenance (O&M) manuals shall consist of two basic parts:

1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.

2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.

B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.

1. A comprehensive index

2. A functional description of the entire system, with references to drawings and instructions

3. A complete "as built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance

4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data

5. Full specifications on each item

6. Detailed service, maintenance, and operation instructions for each item supplied

7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier

9. References to manufacturers' standard literature where applicable.

10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.

D. The operating instructions shall clearly describe the step by step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.

E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.

F. The hardware maintenance documentation shall include, as a minimum, the following information:

1. Operation Information: This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

2. Preventive Maintenance Instructions: These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

3. Corrective Maintenance Instructions: These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

4. Parts Information: This information shall include the identification of each replaceable or field repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between equipment numbers and manufacturer's part numbers shall be provided.

G. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:

1. A program abstract that includes:

a. Program Name: The symbolic alphanumeric program name.

b. Program Title: English text identification.

c. Program Synopsis: A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by non-programming-oriented readers.

2. A program description that shall include, but not be limited to, the following:

a. Applicable Documents: List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.

b. Input Output: Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.

c. Processing: This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall

also be made to an appendix or control strategy document for equation and program algorithm derivations.

d. System Configuration: Describe in detail the system configuration or status required for program implementation, if appropriate.

e. Limitations and Constraints: Summarize all known or anticipated limitations of the program, if appropriate.

f. Storage: Define program storage requirements in terms of disk or RAM memory allocation.

g. Verification: Describe, as a minimum, a test that can be used by the operator to ensure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.

h. Diagnostics: Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.

i. Malfunction Procedures: Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

## 1.11 FINAL SYSTEM DOCUMENTATION

A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.

B. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11- X 17-inch original reproducible prints. All diagrams shall be corrected to describe final "as built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

C. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as built software configurations.

D. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

E. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control

strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.

F. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.

G. The Owner recognizes the fact that not all possible problems related to real time events, software interlocks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

## 1.12 PROGRAMS AND SOURCE LISTINGS

A. Provide one copy of all standard, off-the-shelf system and application software (exclusive of firmware resident software) on original media furnished by the software manufacturer.

B. Provide one copy of source listings on digital media, acceptable to Engineer, for all custom software/logic written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

C. All software/logic shall be in both its native format and in Adobe Portable Document Format.

## 1.13 SUBMITTAL/DOCUMENTATION FORMAT

A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.

B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word or in searchable Portable Document Format (.pdf) format. Raster scans will not be accepted.

## 1.14 ELECTRONIC O&M MANUALS

A. Subject to acceptance by the Engineer, the O&M information may be submitted in part or in whole in an electronic format on digital media.

B. Electronic O&M manuals shall contain information in standard formats (searchable .pdf, Word, AutoCAD, HTML, etc.) and shall be easily accessible using standard, “off-the-shelf” software such as an Internet browser. Raster scans will not be accepted.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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# SECTION 40 61 21
# PROCESS CONTROL SYSTEM TESTING

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21.71 – Factory Witness Test

C. Section 40 61 21.72 – Field Testing

D. Section 40 61 21.73 – Final Acceptance Test

### 1.03 SUBMITTALS

A. For each of the specified tests, submit a test plan to the Engineer at least 1 month in advance of commencement of the tests. The test plan shall contain the following at a minimum:

1. A schedule of all testing to be conducted
2. A brief description of the testing to be performed
3. Test objectives
4. Testing criteria per the Specifications
5. Check lists and procedures for performing each of the specified tests
6. Sample test result documentation
7. Requirements for other parties

### 1.04 GENERAL REQUIREMENTS

A. All system startup and test activities shall follow detailed test procedures; check lists, etc., previously approved by the Engineer. The Engineer shall be notified at least 21 days in advance of any system tests and reserves the right to have their and/or the Owner's representatives in attendance.

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B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

C. The Contractor (or designee) shall maintain master logbooks for each phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.

D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.

E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

F. All testing shall include time for unstructured testing where Owner and Engineer shall have access to the equipment for testing previously undefined normal and abnormal aspects, situations, and functions. Contractor or his/her designee shall provide assistance during this time, including but not limited to documenting the unstructured testing. Owner’s and Engineer’s unstructured testing scenarios may not be available prior to the testing period.

G. If, in the Engineer’s or Owner’s opinion, Contractor is not ready for witness testing and Engineer is present, Contractor shall reimburse Owner for Engineer’s labor to attend the test. Witness testing shall then be rescheduled, with sufficient notice. In the event that Engineer has traveled, even if only to the project-site, for the testing, Engineer’s travel costs shall also be reimbursed. In the event that the Owner has traveled for the testing, Owner’s travel costs shall also be reimbursed.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

# SECTION 40 61 21.71
# FACTORY WITNESS TEST

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall perform a Factory Witness Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.72 – Field Testing

D. Section 40 61 21.73 – Final Acceptance Test

### 1.03 FACTORY WITNESS TEST

A. The Control and Information System equipment shall not be shipped until the Contractor receives notice of acceptability of the factory tests.

B. Each item of equipment shall be fully factory inspected, calibrated and tested for function, operation and continuity of circuits. Exceptions shall be approved in writing by the Engineer.

C. Each subsystem shall be fully factory tested for function and operation.

D. System performance shall be tested using a fully integrated system, including all software and hardware. To achieve this, the entire control system, including all peripheral devices and all interconnecting cables (field instruments are not included in this requirement), shall be assembled on the factory test floor and the complete operational program loaded and simulated inputs applied.

E. All hardware and software required to perform the specified testing shall be furnished by the Contractor at no additional cost to the Owner.

F. The instrumentation and control system subcontractor shall perform a 100-hour full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. If a system component fails during the test, the 100-hour test period shall be restarted after its operation is restored.

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G. The factory testing shall demonstrate all aspects of system sizing and timing including:

1. Monitoring and control scan times at the PLC level

2. Response times at the operator workstation level

H. The overall system as well as individual component hardware shall be tested under conditions of power failure to ensure proper response as specified herein.

I. Operator Workstation Operation: This demonstration shall provide proof of system operation on an individual subsystem basis first, and then in the expected operating environment. Both normal and abnormal operating modes shall be demonstrated. Operator workstation testing shall include the following:

1. Demonstrate proper operation, under both normal and abnormal conditions of the operator workstation application software (SCADA, remote alarm dial-up, etc.). This shall include demonstration of system on-line diagnostics, fail-over features, reconfiguration operations, system initialization and restart, software fault tolerance, error detection and recovery, communications, and all additional features necessary to assure the successful operation of the system.

2. Demonstrate the standard features of the system. This shall include proof of operation of the process control database generator, the display generator, data storage and retrieval functions, data acquisition and control, trending functions, and reporting functions.

3. Demonstrate the configuration of the system to verify conformance with the Contract Documents. This shall include graphic displays and vectoring, operator interface functions, trending, reports, alarm management, security system configuration, etc.

4. The system shall be operated with data input/output with the PLCs and associated panels to prove operation of all workstation functions.

5. The testing in Items 2 and 3 previously listed herein may be performed concurrently (i.e., the standard and configured features of the system may be demonstrated simultaneously).

J. PLC Operation: All functions comparable to those demonstrated for the operator workstations shall be demonstrated on the PLCs. This shall include the following:

1. On-line and off-line diagnostics

2. For redundant units, fail-over operation and reconfiguration

3. System initialization and restart

4. Network communications, including fieldbus communications where required

5. Non-volatility of memory

6. Operation of all control logic shall be demonstrated as described herein

K. Process I/O Simulation: Process input/output simulation for PLCs shall be performed with a manual simulation control panel, a separate PLC, network-based simulation software, analog signal generators, and/or jumpering of discrete signals between outputs and associated inputs, or some combination of these. Alternate process I/O systems such as plug-in circuit cards or I/O test modules may be utilized subject to approval by the Engineer to provide the specified simulation functions. The simulation system shall provide analog and discrete I/O hardware devices in sufficient quantity to allow complete and thorough testing of the control strategies and functions of the system. The process I/O simulation system shall be used in several ways as follows:

1. To provide a means of communications checkout from the operator workstations through the various levels of software in the PLCs and to the process, i.e., the simulation panel. Likewise, a discrete or analog input shall be initiated from the simulation panel and the result monitored at the workstations.

2. Alarm response to discrete status changes or analog value limits shall be verified. Database entries or attributes such as engineering units and conversion equations shall be verified by varying analog inputs.

3. To provide data for use at all levels of the control system at the time of system integration.

L. Control Strategy Testing: Provision shall be made to test all control strategies to prove the integrity of each strategy and the process control language in which it is implemented. For each control strategy, all functions shall be tested individually (where possible) and collectively to verify that the control strategy performs as described herein and as required for overall functionality within the control system.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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# SECTION 40 61 21.72
# FIELD TESTING

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.71 – Factory Witness Test

D. Section 40 61 21.73 – Final Acceptance Test

E. Section 40 70 00 – Instrumentation for Process Systems

### 1.03 GENERAL REQUIREMENTS

A. Control system startup and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:

1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Section 40 70 00 – Instrumentation for Process Systems.

2. Each final control element shall be individually tested as specified hereinafter.

3. Each control loop shall be tested as specified hereinafter.

4. Each control strategy shall be tested under automatic digital control as specified hereinafter.

5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.

B. System startup and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.

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C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

## 1.04 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.

C. The Contractor shall ensure that the electrical subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.

D. The Contractor shall ensure that the HVAC subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function of all HVAC system control and interlock circuitry and the transmission of all discrete and/or analog signals between HVAC equipment and controls and the control system specified herein.

## 1.05 FINAL CONTROL ELEMENT TESTING

A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFDs, that require turndown limits shall be initially set during this test.

C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

## 1.06 LOOP CHECKOUT

A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all DACs shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.

D. The accuracy of all ADCs shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.

E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

## 1.07 CONTROL SYSTEM STARTUP AND TESTING

A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.

C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.

D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.

E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.

F. The control system start-up and test activities shall include running tests to prove that the Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.

H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

## 1.08 FACILITY STARTUP COORDINATION

A. Facility startup shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.

B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (8 hours/day, 5 days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the startup period.

D. At least one qualified control systems technician shall be provided for control system startup and test activities and at least two when loop checkout is being performed.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

# SECTION 40 61 21.73
# FINAL ACCEPTANCE TEST

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall perform the Final Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.71 – Factory Witness Test

D. Section 40 61 21.72 – Field Testing

### 1.03 AVAILABILITY DEMONSTRATION AND FINAL SYSTEM ACCEPTANCE

A. Upon completion of all control system startup activities and prior to final system acceptance, the Contractor shall demonstrate that the availability of the entire control system, including operation under conditions of digital equipment fail-over, initiated either automatically or manually, shall be not less than 99.8 percent during a 30-day availability test period. The Owner shall be given 2 weeks' notice of the starting date of the 30-day availability test.

B. For purposes of determining availability figures, downtime of each system or portions of each system resulting from the causes specified hereunder will not be considered system failures.

1. Downtime of any network-connected device that is automatically backed-up upon failure shall not be considered a system failure provided that the downtime of the failed component does not exceed 24 hours.

2. Downtime of a PLC that is not automatically backed-up shall be considered a system failure if the downtime of the failed controller exceeds 1 hour.

3. Downtime of a portion of the system resulting from failure of any field sensor shall not be considered a system failure provided that the system operates as specified under this condition.

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4. Downtime of the following devices shall not be considered a system failure provided the failed device is repaired within the specified time:

    a. Communication interfaces (8 hours)

    b. Process control system networks (8 hours)

    c. UPS unit (1 day)

5. Total shutdown of a single PLC resulting from a software fault shall be considered a system failure.

6. An erroneous command to the process that can be specifically related to a software fault shall be considered as 1 hour of downtime.

7. The inoperability of any subsystem resulting from a software fault shall be considered a system failure.

8. The failure of the same component more than one time during the 30-day test shall be considered a system failure.

C. If the system fails the 30-day availability test, the 30-day test period shall be restarted after the failed component or software is repaired/replaced and full operation is restored. The system shall be demonstrated for the full 30-day period following the restart.

D. The Contractor shall submit an availability demonstration report that shall state that all system availability requirements have been met.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 40 61 22

## TOOLS, SUPPLIES, AND SPARE PARTS, GENERAL

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

### PART 2 – PRODUCTS

### 2.01 TOOLS

A. Furnish special tools, other than those normally found in an electronic technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any digital equipment, instrument, panel, rack, cabinet or console mounted equipment for service and maintenance. This shall include, but not be limited to, the following: connector pin insertion and removal tools, wire crimping tools, special wrenches, special instrument calibrators, indicator lamp insertion and removal tools, etc.

B. Furnish tools and test equipment together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking field operation of equipment supplied under this Division.

C. Furnish one portable graphical multimeter with rechargeable battery, test leads, industrial lead set, and carrying case, Fluke Model 289, Simpson, or equal.

D. Furnish one portable 4-20 mA, 24 VDC analog loop signal generator for calibration and testing of analog signal loops. Generator shall be furnished with rechargeable battery pack, test leads, spare battery pack, charger, carrying case and accessories. Signal generator shall be Fluke 787 ProcessMeter, or equal.

E. Furnish one complete computer technician kit in an organized soft-sided case. The kit shall be Model JTK-49CBR Workstation Kit by Jensen Tools & Supply or a computer technician kit of equivalent equipment and value.

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## 2.02 SUPPLIES

A. The Contractor shall provide supplies as specifically required in other Sections of Division 40.

## 2.03 SPARE PARTS

A. Furnish spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.

B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.

C. The Contractor shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.

D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

## PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

## SECTION 40 61 23
## SIGNAL COORDINATION REQUIREMENTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall conform to the signal coordination requirements specified herein.

B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, the HVAC subcontractor, and the instrumentation and control system subcontractor.

C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLCs and Control System PLCs.

D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLCs, the Control System, etc.

### 1.02 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 VDC.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.

E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs hall be converted to an isolated, linear, 4-20 milliampere signal.

F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation and control system subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.

H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation and control system subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

## 1.03 DISCRETE INPUTS

A. All discrete inputs to equipment and Control and Information System PLCs, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLCs, unless specified otherwise.

B. Sensing power (wetting voltage) supplied by the PLC shall be 120 VAC.

## 1.04 DISCRETE OUTPUTS

A. All discrete outputs from local control panels and Control and Information System PLCs to field devices, starters, panels, etc., shall be dry contact relay outputs.

B. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.

C. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

## 1.05 OTHER DISCRETE SIGNALS

A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.

B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.

C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.

D. The previously listed requirements shall apply to all starters and panels, regardless of supplier.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

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## SECTION 40 61 24
## QUALITY ASSURANCE

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. It is the intent of these Specifications and Drawings to secure high quality in materials, equipment and workmanship in order to facilitate operations and maintenance of the facility. The Contractor shall provide equipment and services to meet this intent.

### 1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All instrumentation and control system work shall be installed in accordance with the NEC, National Electric Safety Code, OSHA, State/Commonwealth, local and other applicable codes.

### 1.03 QUALITY ASSURANCE - GENERAL

A. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.

B. For uniformity, only one manufacturer and model will be accepted for each type of product. Where differing models are required, equipment from a single manufacturer shall be provided.

C. Equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for stresses that may occur during fabrication, transportation, and erection as well as during continuous or intermittent operation. They shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.

D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service.

E. Electronic components shall be de-rated to assure dependability and long-term stability.

F. Printed circuit boards in field mounted equipment shall be suitable for the specified environmental conditions.

G. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers.

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H. Components of specially selected values shall not be inserted into standard electronic assemblies in order to meet the performance requirements of this specification.

## 1.04 OPTIONAL EQUIPMENT

A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the Owner. In the event that the changes are necessary, calculations and drawings showing the proposed revisions shall be submitted for approval. The Contractor shall coordinate changes with other affected trades and contracts and pay additional charges incurred.

## 1.05 GUARANTEE

A. The instrumentation and control system subcontractor through the Contractor shall install, maintain and guarantee the Instrumentation, Control and Information System as specified under the General Conditions and Division 01 of the Specifications. Maintenance personnel provided by the instrumentation and control system subcontractor shall instruct the Owner's personnel in the operation, adjustment, calibration and repair of the equipment being serviced. Preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe work performed and list materials used. A copy of service reports shall be delivered to the Owner on the day the work is performed.

B. The instrumentation and control system subcontractor shall provide the services of factory-trained service technician(s) at least twice during the guarantee period, for the purpose of performing preventive hardware maintenance.

C. Corrective hardware and software maintenance during the guarantee period shall be performed in accordance with the requirements of Division 01 and, in addition, shall meet the following requirements:

1. Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the Owner.

2. Corrective software maintenance shall be performed for software provided by the instrumentation and control system subcontractor and incorporated into the system prior to the completion of system commissioning. Software service programmer(s) shall be available for consultation within four business hours and, if required, on-site within 16 business hours after notification by the Owner. Corrective

software maintenance shall include the supply, installation and startup of application software upgrades released during the guarantee period.

3. Corrective hardware and software maintenance performed during the guarantee period shall be performed at no cost to the Owner.

4. As used herein, the term "working hours" shall be defined as those of the treatment facility (7 days per week, 24 hours per day). The term "business hours" shall be defined as the hours between 8 a.m. and 5 p.m., local time, Monday through Friday; excluding holidays.

5. The guarantee period shall commence upon final acceptance of the completed treatment facility in accordance with the provisions of the Contract Documents.

D. The instrumentation and control system subcontractor shall submit to the Owner a proposed maintenance agreement incorporating the following features:

1. Extension of preventive hardware maintenance services as previously described for a period of up to 5 years from the expiration of the warranty period.

2. Provisions for corrective hardware or software maintenance work on a will-call basis for a period of up to 5 years from the expiration of the warranty period. Corrective maintenance work shall be performed by properly trained personnel as previously described.

E. The proposed agreement shall include provisions for payment based upon an annual fee for preventive maintenance and cost plus expenses for corrective maintenance work. The portion dealing with corrective maintenance shall be written to include corrective maintenance caused by actions of the Owner during the warranty period and shall contain clauses for renegotiation of contract prices based upon changes in recognized economic indicators published by the United States Department of Commerce.

## 1.06 SHIPPING HANDLING AND STORAGE

A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of field instrumentation, panels, digital equipment and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

## 1.07 FABRICATION

A. Fabrication of equipment shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The Engineer may inspect the fabricated equipment at the factory before shipment to Project Site. The Contractor shall provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.

C. Equipment approval at the factory only allows the equipment to be shipped to the Project Site. The Contractor shall provide for the proper storage, installation and satisfactory start-up and operation of the equipment to the satisfaction of the equipment manufacturer, the instrumentation and control system subcontractor, and the Engineer.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Instrumentation and control system installation work, whether new construction or modifications to existing equipment/panels/structures, shall conform to the codes and standards outlined in this Section and other portions of the Contract Documents.

B. The instrumentation and control system subcontractor shall assign a competent representative who shall provide full time coordination and supervision of on-site instrumentation and control system construction work from commencement of construction through completion and final acceptance.

C. Labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of three years of documented experience on similar projects.

D. Equipment and materials shall fit properly in their installations. Work required to correct improperly fit installations shall be performed at no additional expense to the Owner.

E. Work shall be performed in a neat and workmanlike manner. Hardware and instrumentation shall be installed in accordance with requirements specified herein, in accordance with industry best practices, in accordance with manufacturers' recommendations, and in a manner suitable for ease of operation, inspection, and maintenance. Wiring shall be neatly bundled, run in wireway, and terminated. Spare wiring shall be neatly coiled and clearly labeled at both ends for future use by the Owner. Work not meeting these requirements shall be corrected at no expense to the Owner.

F. Sufficient common-mode and differential-mode noise rejection shall be provided to ensure proper operation of the plant process control system. General practices shall include:

1. Maintaining crossings between noisy wires and signal wires at right angles.

2. Maintaining separation between noisy wires and signal wires as wide as practical.

3. Grounding all signals, shields and power supplies at the process control unit or local control panel.

4. Providing passive filters on signals with time constant compatible with scan intervals and overvoltage protection.

5. Eliminating cable splices. Splices in instrumentation and control system signal, network, and instrument manufacturer furnished cables shall be approved in advance by the Engineer.

6. Providing a floating output for transmitters that have their own power sources.

G. DC and AC power grounding shall be performed in accordance with the digital hardware manufacturer's recommendations as well as all applicable code requirements.

H. The case of each field instrument and control panel shall be grounded in compliance with the NEC.

I. Power wires shall be separated from parallel-running signal wires by the following minimum spacing:

1. 120VAC: 12 in

2. 240VAC: 18 in

3. 480VAC: 18 in

4. 2000VAC and above: 24 in

J. The Contractor shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports. Embedded supports for equipment furnished under this Division shall be provided and installed as shown specified herein and shown on the Drawings.

K. Following acceptance of the factory tests by the Engineer, and in accordance with the construction schedule, the Contractor shall commence installation of the digital control system hardware. Digital system equipment items shall not be installed, however, until all architectural, mechanical, HVAC and electrical work has been completed in the

equipment rooms, MCCs, control rooms and all structural and mechanical work has been completed within 50 feet of equipment locations.

L. Upon completion of the previously listed construction work, the Contractor shall request an inspection of the previously-named areas. The Engineer will issue a written approval to proceed with delivery and installation only after being satisfied that all Work previously described has been properly performed. Digital equipment shall remain at the factory site or storage prior to approval for delivery to the Project Site. Partial shipments may be required to meet construction schedule requirements.

**END OF SECTION**

# SECTION 40 61 91
# PROCESS CONTROL SYSTEM INSTRUMENT LIST

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 93 – Process Control System Input/Output List

B. Section 40 61 96 – Process Control Descriptions

## PART 2 – PRODUCTS

### 2.01 NAMEPLATES

A. Items of equipment listed in the instrument schedule, control panels, and digital hardware items shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.

C. Nameplates shall be attached to metal equipment by NEMA-rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.

D. Submit sample nameplate of each type.

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## PART 3 – INSTRUMENT SCHEDULE

1. See following Instrument List

**END OF SECTION**

**Flow Switches (Thermal)-Specification 40 71 79.16**

| Tag Number | Service Description | Range | Setpoint | Drawing | Remarks |
|---|---|---|---|---|---|
| FSH-26800 | ODOR CONTROL PROCESS WATER FLOW SWITCH | | 1 = OK | 26-I-004 | |

**Level Switches (Floats)-Specification 40 72 76.26**

| Tag Number | Service Description | Range | Setpoint | Drawing | Remarks |
|---|---|---|---|---|---|
| LSL-27110 | FINAL EFFLUENT PUMP STATION SUMP LEVEL SWITCH LOW | | 1 = OK | 27-I-001 | |

**Pressure and Differential Pressure Gauges-Specification 40 73 13**

| Tag Number | Service Description | Range | Setpoint | Drawing | Remarks |
|---|---|---|---|---|---|
| PI-27111 | FINAL EFFLUENT PUMP 1 DISCHARGE PRESSURE | 0-100 PSI | | 27-I-001 | |
| PI-27112 | FINAL EFFLUENT PUMP 1 DISCHARGE PRESSURE | 0-100 PSI | | 27-I-001 | |

**Single Point Gas Monitoring Systems-Specification 40 76 21**

| Tag Number | Service Description | Range | Setpoint | Drawing | Remarks |
|---|---|---|---|---|---|
| AIT-26004 | COMBUSTIBLE GAS AND VENTILATION H2S SENSOR | 0-100 PPM | | 26-I-008 | |

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## SECTION 40 61 93
## PROCESS CONTROL SYSTEM INPUT / OUTPUT LIST

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all control system inputs and outputs as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 91 – Process Control System Instrument List

B. Section 40 61 96 – Process Control Descriptions

### PART 2 – CONTROL SYSTEM INPUT/OUTPUT SCHEDULE

1. See following Control System Input/Output Schedule

2. NOTES: Input/Output types are as follows:

    a. DI: Discrete Input

    b. DO: Discrete Output

    c. AI: Analog Input

    d. AO: Analog Output

    e. RS485: Serial Communications Link

3. All available information from each VFD via its communication port shall be provided to the PLC.

### PART 3 – EXECUTION (NOT USED)

**END OF SECTION**

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**INPUT/OUTPUT LIST**

| Tag Number | Service Description | Function | PLC | TYPE | Drawing | Remarks |
|---|---|---|---|---|---|---|
| SI-27111 | FINAL EFFLUENT WATER PUMP 1 | SPEED FEEDBACK | LCP-11 | AI | 27-I-001 | |
| SI-27112 | FINAL EFFLUENT WATER PUMP 2 | SPEED FEEDBACK | LCP-11 | AI | 27-I-001 | |
| SC-27111 | FINAL EFFLUENT WATER PUMP 1 | SPEED COMMAND | LCP-11 | AO | 27-I-001 | |
| SC-27112 | FINAL EFFLUENT WATER PUMP 2 | SPEED COMMAND | LCP-11 | AO | 27-I-001 | |
| LAL-27110 | FINAL EFFLUENT WET WELL | LEVEL ALARM LOW | LCP-11 | DI | 27-I-001 | |
| IAH-27111 | FINAL EFFLUENT WATER PUMP 1 | OVERLOAD | LCP-11 | DI | 27-I-001 | |
| MAH-27111 | FINAL EFFLUENT WATER PUMP 1 | HIGH MOISTURE | LCP-11 | DI | 27-I-001 | |
| TAH-27111 | FINAL EFFLUENT WATER PUMP 1 | HIGH TEMPERATURE | LCP-11 | DI | 27-I-001 | |
| YA-27111A | FINAL EFFLUENT WATER PUMP 1 | VFD FAULT | LCP-11 | DI | 27-I-001 | |
| YA-27111B | FINAL EFFLUENT WATER PUMP 1 | COMMON FAULT | LCP-11 | DI | 27-I-001 | |
| YN-27111A | FINAL EFFLUENT WATER PUMP 1 | RUNNING | LCP-11 | DI | 27-I-001 | |
| YN-27111B | FINAL EFFLUENT WATER PUMP 1 | IN AUTO | LCP-11 | DI | 27-I-001 | |
| IAH-27112 | FINAL EFFLUENT WATER PUMP 2 | OVERLOAD | LCP-11 | DI | 27-I-001 | |
| MAH-27112 | FINAL EFFLUENT WATER PUMP 2 | HIGH MOISTURE | LCP-11 | DI | 27-I-001 | |
| TAH-27112 | FINAL EFFLUENT WATER PUMP 2 | HIGH TEMPERATURE | LCP-11 | DI | 27-I-001 | |
| YA-27112A | FINAL EFFLUENT WATER PUMP 2 | VFD FAULT | LCP-11 | DI | 27-I-001 | |
| YA-27112B | FINAL EFFLUENT WATER PUMP 2 | COMMON FAULT | LCP-11 | DI | 27-I-001 | |
| YN-27112A | FINAL EFFLUENT WATER PUMP 2 | RUNNING | LCP-11 | DI | 27-I-001 | |
| YN-27112B | FINAL EFFLUENT WATER PUMP 2 | IN AUTO | LCP-11 | DI | 27-I-001 | |
| HS-27110 | FINAL EFFLUENT PUMP STATION | PUMP STATION RUN | LCP-11 | DO | 27-I-001 | |
| YA-23104 | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | FAULT | LCP-23 | DI | 23-I-001 | |
| YN-23104A | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | RUNNING | LCP-23 | DI | 23-I-001 | |
| YN-23104B | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | IN AUTO | LCP-23 | DI | 23-I-001 | |
| HS-23104 | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | RUN | LCP-23 | DO | 23-I-001 | |
| YA-24411 | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | FAULT | LCP-24 | DI | 24-I-001 | |
| YN-24411A | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | RUNNING | LCP-24 | DI | 24-I-001 | |
| YN-24411B | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | IN AUTO | LCP-24 | DI | 24-I-001 | |
| HS-24411 | DEWATERED CAKE FEED CONVEYOR 2 CON24411 | RUN | LCP-24 | DO | 24-I-001 | |
| AI-26004 | COMBUSTIBLE GAS AND VENTILATION DRYER BUILDING | H2S CONC | LCP-26 | AI | 26-I-008 | |
| EA-26000 | LCP-26 UNINTERRUPTIBLE POWER SUPPLY | LOW BATTERY | LCP-26 | DI | - | |
| YA-26000A | LCP-26 UNINTERRUPTIBLE POWER SUPPLY | AC LINE LOSS | LCP-26 | DI | - | |
| YA-26000B | LCP-26 UNINTERRUPTIBLE POWER SUPPLY | FAULT | LCP-26 | DI | - | |
| YA-26002A | HVAC CONTROL PANEL | HV UNIT GENERAL ALARM | LCP-26 | DI | 26-I-008 | |
| YA-26002B | HVAC CONTROL PANEL | EXHAUST FAN GENERAL ALARM | LCP-26 | DI | 26-I-008 | |
| YA-26002C | HVAC CONTROL PANEL | EXHAUST LOW FLOW GENERAL | LCP-26 | DI | 26-I-008 | |
| YA-26002D | HVAC CONTROL PANEL | SUPPLY LOW FLOW GENERAL AL | LCP-26 | DI | 26-I-008 | |
| YA-26002E | HVAC CONTROL PANEL | SERVICE MODE STATUS | LCP-26 | DI | 26-I-008 | |
| HS-26005A | COMBUSTIBLE GAS AND VENTILATION NORTH DOOR | GO | LCP-26 | DI | 26-I-008 | |
| HS-26005B | COMBUSTIBLE GAS AND VENTILATION NORTH DOOR | NO GO | LCP-26 | DI | 26-I-008 | |
| HS-26006A | COMBUSTIBLE GAS AND VENTILATION SOUTH DOOR | GO | LCP-26 | DI | 26-I-008 | |
| HS-26006B | COMBUSTIBLE GAS AND VENTILATION SOUTH DOOR | NO GO | LCP-26 | DI | 26-I-008 | |
| HS-26007A | COMBUSTIBLE GAS AND VENTILATION EAST DOOR | GO | LCP-26 | DI | 26-I-008 | |
| HS-26007B | COMBUSTIBLE GAS AND VENTILATION EAST DOOR | NO GO | LCP-26 | DI | 26-I-008 | |
| HS-26008A | COMBUSTIBLE GAS AND VENTILATION WEST DOOR | GO | LCP-26 | DI | 26-I-008 | |
| HS-26008B | COMBUSTIBLE GAS AND VENTILATION WEST DOOR | NO GO | LCP-26 | DI | 26-I-008 | |
| YA-26010A | FIRE ALARM CONTROL PANEL | FIRE ALARM | LCP-26 | DI | 26-I-008 | |
| YA-26010B | FIRE ALARM CONTROL PANEL | TROUBLE ALARM | LCP-26 | DI | 26-I-008 | |
| YA-26010C | FIRE ALARM CONTROL PANEL | SUPERVISORY ALARM | LCP-26 | DI | 26-I-008 | |
| YA-26010D | FIRE ALARM CONTROL PANEL | WET SYSTEM ACTIVE | LCP-26 | DI | 26-I-008 | |
| YA-26010E | FIRE ALARM CONTROL PANEL | FOAM SUPPRESSION SYSTEM AC | LCP-26 | DI | 26-I-008 | |
| FAH-26800 | ODOR CONTROL PROCESS WATER FLOW ALARM HIGH | FLOW ALARM HIGH | LCP-26 | DI | 26-I-004 | |
| YN-26910 | DRY PRODUCT CONVEYOR SYSTEM | SYSTEM RUNNNG | LCP-26 | DI | 26-I-007 | |
| YA-26911 | DRY PRODUCT CONVEYOR CON26911 | FAULT | LCP-26 | DI | 26-I-007 | |
| YN-26911 | DRY PRODUCT CONVEYOR CON26911 | RUNNING | LCP-26 | DI | 26-I-007 | |

| Tag Number | Service Description | Function | PLC | TYPE | Drawing | Remarks |
|---|---|---|---|---|---|---|
| YA-26912 | DRY PRODUCT CONVEYOR CON26912 | FAULT | LCP-26 | DI | 26-I-007 | |
| YN-26912 | DRY PRODUCT CONVEYOR CON26912 | RUNNING | LCP-26 | DI | 26-I-007 | |
| YA-26005 | COMBUSTIBLE GAS AND VENTILATION NORTH DOOR | NO GO | LCP-26 | DO | 26-I-008 | |
| YN-26005 | COMBUSTIBLE GAS AND VENTILATION NORTH DOOR | GO | LCP-26 | DO | 26-I-008 | |
| YA-26006 | COMBUSTIBLE GAS AND VENTILATION SOUTH DOOR | NO GO | LCP-26 | DO | 26-I-008 | |
| YN-26006 | COMBUSTIBLE GAS AND VENTILATION SOUTH DOOR | GO | LCP-26 | DO | 26-I-008 | |
| YA-26007 | COMBUSTIBLE GAS AND VENTILATION EAST DOOR | NO GO | LCP-26 | DO | 26-I-008 | |
| YN-26007 | COMBUSTIBLE GAS AND VENTILATION EAST DOOR | GO | LCP-26 | DO | 26-I-008 | |
| YA-26008 | COMBUSTIBLE GAS AND VENTILATION WEST DOOR | NO GO | LCP-26 | DO | 26-I-008 | |
| YN-26008 | COMBUSTIBLE GAS AND VENTILATION WEST DOOR | GO | LCP-26 | DO | 26-I-008 | |
| YA-26009A | COMBUSTIBLE GAS AND VENTILATION DRYER BUILDING | HORN | LCP-26 | DO | 26-I-008 | |
| YA-26009B | COMBUSTIBLE GAS AND VENTILATION DRYER BUILDING | BEACON | LCP-26 | DO | 26-I-008 | |
| YC-26910 | DRY PRODUCT CONVEYOR SYSTEM | RUN COMMAND | LCP-26 | DO | 26-I-007 | |

# SECTION 40 61 96
# PROCESS CONTROL DESCRIPTIONS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.

B. Together with the control system input/output schedule, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. THE FUNCTIONAL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.

D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.

E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the functional descriptions as required to provide all functions specified herein shall be furnished by the electrical subcontractor under Division 26 – Electrical. The electrical subcontractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 14 00 – Coordination with Owner's Operations

B. Section 40 61 91 – Process Control System Instrument List

C. Section 40 61 93 – Process Control System Input/Output List

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## PART 2 – FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

### 2.01 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

### 2.02 CONVENTIONS

A. Operator workstation graphic display symbols and indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

1. Running/On/Open: Green or Bright

2. Auto/Ready: White

3. Stopped/Off/Closed: Red or Dark

4. Fail/Alarm: Amber

5. Generic Status: Blue or White

### 2.03 PROCESS CONTROL

A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.

2. For alarms and control actions derived from discrete input signals, use adjustable time delays.

3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).

4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.

D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

F. A control discrepancy alarm shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

G. An instrument failure alarm shall be generated for any instrument which is generating a signal that is less than 4 mA or greater than 20 mA.

H. Unless otherwise specified in an individual control description, an instrument failure or control discrepancy alarm shall cause the control strategy to maintain last values and to generate an alarm. Manual initiation of the automatic control strategy shall be required.

I. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

J. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

## PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS

### TABLE OF CONTENTS


| Number | Title |
|---|---|
| 40 61 96A | SCREW CONVEYORS |
| 40 61 96B | VENTILATION MONITORING AND ALARMS |
| 40 61 96C | FINAL EFFLUENT WATER PUMP STATION |


### END OF SECTION

**SECTION 40 61 96A**

**PROCESS CONTROL DESCRIPTIONS – SCREW CONVEYORS**

**PART 1 – (SEE SECTION 40 61 96)**

**PART 2 – (SEE SECTION 40 61 96)**

**PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS**

**3.01 DEWATERED CAKE FEED CONVEYORS**

Process Overview

Two proposed sludge conveyors will transfer dewatered sludge cake from existing belt filter presses in Dewatering Building Nos. 1 and 2 to the proposed dewatered cake feed hoppers to subsequently be fed to the Thermal Dryer Facility building. The dewatered cake feed conveyors to be furnished under Section 46 76 42 – Screw Conveyors include the following: Dewatered Cake Feed Conveyor No. 1 (CON23104) and Dewatered Cake Feed Conveyor No. 2 (CON24411). Conveyors CON23104 and CON24411 each include one slide gate on the conveyor discharge chute: G23105 and G24421. Conveyor control panels CCP-CON23104 and CCP-CON24411 shall be provided under Section 46 07 01 – Packaged Control Panels and Section 46 76 42 – Screw Conveyors to control the conveyors and coordinate their operation with the wet cake hoppers and upstream conveyors.

A. Control Operation

1. General/Field Controls

a. Each conveyor will be operated either manually or automatically through its respective conveyor control panel. In Auto mode, the conveyors will operate as a system in response to a Conveyor System Run command from the Thermal Dryer Facility PLC.

b. The operator will manually open and close the electrically actuated slide gates on the conveyors either at the conveyor control panel or from actuator remote control stations mounted in the truck loading bay.

c. Each conveyor control panel shall provide the following I/O to LCP-23 and LCP-24 respectively:

1) Conveyor Fault - DO to LCP

2) Conveyor Running - DO to LCP

3) Run Command - DI from LCP

## 3.02 DRIED PRODUCT CONVEYORS

Process Overview

Two proposed sludge conveyors will transfer dried product from the thermal dryer system to trucks for the removal of dried product from the WPCP. The dried product conveyors to be furnished under Section 46 76 42 – Screw Conveyors include the following: Dried Product Transport Conveyor CON26911 and Dried Product Truck Loading Conveyor CON26912. Conveyor control panel CCP-CON26912 shall be provided under Section 46 07 01 – Packaged Control Panels and Section 46 76 42 – Screw Conveyors to control the conveyors and coordinate their operation with the thermal dryer system and the upstream conveyors.

A. Control Operation

1. General/Field Controls

a. The dried product conveyors shall be operated either manually or automatically through the conveyor control panel. In Auto mode, the conveyors shall operate as a system in response to a Conveyor System Run command from the Thermal Dryer Facility PLC.

b. The conveyor control panel shall provide the following I/O to LCP-26:

1) Conveyor Fault (two): DO to LCP-26

2) Conveyor Running (two): DO to LCP-26

3) Conveyor System Running: DO to LCP-26

4) Run Command for Conveyor System: DI from LCP-26

**END OF SECTION**

## SECTION 40 61 96B

## PROCESS CONTROL DESCRIPTIONS – VENTILATION MONITORING AND ALARMS

**PART 1 – (SEE SECTION 40 61 96)**

**PART 2 – (SEE SECTION 40 61 96)**

**PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS**

### 3.1 VENTILATION MONITORING AND ALARMS

A. Process Overview

The Thermal Dryer Facility at the Fitzgerald Creek WPCP is classified under NFPA 820 and has been declassified by providing monitoring and continuous ventilation. Local horns and beacons and remote SCADA alarms shall alert plant personnel of ventilation failure.

B. Control Operation

1. Thermal Dryer Facility (TDF)

a. Air flow switches for supply and exhaust fans in the Dryer Room of the TDF shall transmit a single discrete fault signal to LCP-26 in the event of low air flow from HVCP-TDF.

b. Combustible Gas Detectors for H2S in the Dryer Room of the TDF shall transmit analog signals to LCP-26 for monitoring.

c. Under normal circumstances, the Go indicator light at the local control panels shall be energized. If any one of the supply or exhaust fans fails or if the H2S analyzer reads high concentrations, LCP-26 shall provide discrete outputs to energize the No Go light and de-energize the Go light at the local control panels and to energize the horns and beacons at the local alarm panels.

d. The alarm horns shall be silenced by depressing the Silence pushbutton on one of the local control panels, but the alarm beacons shall remain illuminated until the failure condition is corrected.

| Local Control Panel | Panel Type |
|---|---|
| LCP-26005 | Control |
| LCP-26006 | Control |
| LCP-26007 | Control |
| LCP-26008 | Control |
| LCP-26009A | Alarm |
| LCP-26009B | Alarm |

**END OF SECTION**

## SECTION 40 61 96C

## PROCESS CONTROL DESCRIPTIONS – FINAL EFFLUENT WATER PUMP STATION

**PART 1 – (SEE SECTION 40 61 96)**

**PART 2 – (SEE SECTION 40 61 96)**

**PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS**

### 3.01 FINAL EFFLUENT WATER PUMP STATION

A. Process Overview

A proposed wet well will supply the Thermal Dryer Facility with final effluent water for cooling and other purposes. The final effluent water will be conveyed to the Facility via two proposed wet pit submersible solids-handling pumps, which will be furnished with variable frequency drives (VFDs). Each pump discharge pipeline will be furnished with a pressure indicating gauge. The wet well will be furnished with one low level float switch.

B. Control Operation

1. General/Field Controls

a. When the field HAND-OFF-AUTO (H-O-A) switch is in the HAND position, the pump shall run based off of the START or STOP pushbuttons.

b. When the field H-O-A switch is in the OFF position, the pump shall not run.

c. When the field H-O-A switch is in AUTO, the PLC shall control the pumps.

d. Time delays in the PLC control program for restart after power failure shall be in effect under the AUTO mode of operation.

2. PLC Pump Start/Stop Control

a. When controlled automatically, the pumps shall operate in a Duty/Standby sequence by the Vendor Control Panel. The Duty pump shall be called to run when the PLC sends a Run request.

3. PLC Pump Speed Control

a. When controlled automatically, the duty VFD speed shall be controlled to provide the requested flow rate.

4. PLC Interlocks

    a. The PLC shall stop all operating pump(s) and shall generate an alarm at the HMI upon any of the following conditions:

        1) Low Level signal received

5. PLC Alarms

    a. The PLC shall generate an alarm upon any of the following conditions:

        1) High Moisture signal received

        2) High Temperature signal received

        3) Overload signal received

**END OF SECTION**

## SECTION 40 62 00
## COMPUTER SYSTEM HARDWARE AND ANCILLARIES

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The process control system is physically and functionally distributed between PLC equipped control panels, motor control panels, field panels, operator workstations and appurtenances.

B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance and local monitoring purposes only and shall not be regarded as backup to the PLC-based control system.

C. PLCs may be categorized as either “process PLCs” or “integration PLCs” that are provided by the instrumentation subcontractor or “equipment control PLCs” or “vendor PLCs” or “packaged PLCs” provided by equipment manufacturers for the operation of their equipment (blowers, centrifuges, chemical systems, filters, etc.). Unless otherwise specified, all PLCs provided under this Contract shall conform to the requirements specified in this Division.

D. Major plant control system digital equipment items are described in the Specifications and shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 63 43 – Programmable Logic Controllers

B. Section 40 66 00 – Network and Communication Equipment

### 1.03 DIGITAL HARDWARE CONFIGURATIONS

A. The digital hardware configuration shown on the Control System Architecture Drawing depicts overall system configuration requirements. System design shall be based upon this concept and shall provide an overall digital system availability of 99.8 percent under the conditions specified in Section 40 61 21.73 – Final Acceptance Test. Unless otherwise specified, designs that vary from this concept will be rejected.

B. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. Run time and flow accumulations shall be performed at the PLC level. Except for minimal calculations related to report-specific functions such as minimum, maximum, average, etc., operator workstations shall not be used to perform calculation for the process control system. Operator workstations shall

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be fully independent devices, individually connected to the plant control system networks.

C. No other exceptions will be considered.

## PART 2 – PRODUCTS

### 2.01 GENERAL SYSTEM HARDWARE REQUIREMENTS

A. Unless otherwise specified, all hardware shall be rated for industrial use, resistant to shock, vibration, electromagnetic interference, static discharge, and suitable for the environmental conditions described elsewhere in this Division. Commercial or office grade equipment shall not be accepted.

B. Unless otherwise specified, modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCB's or modules shall be employed for easy removal to permit exposure of circuit wiring, components and test points. Extender boards shall be provided, if necessary, to permit PCB's to be completely exposed for testing purposes.

C. Keying schemes shall be used to prevent PCB misplacement.

D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.

### 2.02 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS

A. No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed up system component is undergoing preventive or corrective maintenance.

B. All devices connected to the plant control system network shall be self-checking and shall report their operational status to the operator workstations as either "normal" or "failed". A graphic display based on the system architecture drawing shall be furnished with the control and information system showing this information along with current communication status of each device.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. Refer to Section 40 61 13 – Process Control System General Provisions, Part 3.

**END OF SECTION**

# SECTION 40 63 43
# PROGRAMMABLE LOGIC CONTROLLERS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all programmable logic controllers (PLC), with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 23 – Signal Coordination Requirements

C. Section 40 62 00 – Control and Information System Hardware - General

D. Section 40 66 00 – Network and Communication Equipment

E. Section 40 67 00 – Control System Equipment Panels and Racks

F. Section 40 67 63 – Uninterruptible Power Systems

### 1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One of each type and size of module for PLC equipment furnished under this Contract.

2. One of each type and size of PLC and equipment power supply furnished under this Contract.

## PART 2 – PRODUCTS

### 2.01 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

A. The instrumentation and control system subcontractor shall furnish PLCs as specified herein and as shown on the Drawings. PLCs shall be provided complete with backplane, power supply, I/O cards, special function cards, instructions, memory, input/output

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capacity, and appurtenances to provide all features and functions as described herein. No substitutions will be permitted.

B. All components of the PLC system shall be of the same manufacturer, who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

C. PLCs shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0 to 60 degrees Celsius and a relative humidity of 5 to 95 percent, non-condensing. The PLC shall operate on supply voltages of 90 to 132VAC at 47-63 Hz or 24VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

D. Where applicable, the minimum PLC backplane size shall be 7 slots, not including power supply slots.

E. System configuration shall be as shown on the Control System Architecture Drawing. PLC types shall be designated on the Control System Architecture Drawing and correspond to the specifications herein. Only a single type of processor shall be supplied for all PLCs of a designated type. Memory and processor shall be adequate for all control functions specified. PLCs shall be as manufactured or equal to the following:

1. Automation Direct Do-more Series BRX

2. Automation Direct Productivity Series

3. Automation Direct Click

4. Allen-Bradley ControlLogix (Vendor / Manufacturer Supplied Alternative)

5. Allen-Bradley CompactLogix (Vendor / Manufacturer Supplied Alternative)

## 2.02 PROCESSORS

A. The processor and its associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or equivalent shall be used to select processor operating mode. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Nonvolatile memory in the form of a manufacturer supplied industrial CompactFlash card or equivalent technology shall be

required to maintain the entire current program and firmware of the controller in the event of power loss. The program shall be updated onto the flash memory each time a program change such as an online edit or tag value is changed. When nonvolatile memory (flash memory) is not available for certain controller models as offered by the PLC manufacturer, lithium batteries shall be used to maintain process RAM memory for at least one year in the event of power loss. The lithium battery unit shall be an externally mounted battery assembly with the highest available capacity. The PLC shall send an alarm to the plant control system if battery level is low.

B. The instruction set for the PLC shall conform to the requirements of IEC 61131-3. Each PLC shall have the capability to run all five of the standard IEC 61131-3 languages simultaneously. These five languages shall be:

1. Ladder Diagram

2. Structured Text

3. Instruction List

4. Function Block Diagram

5. Sequential Function Chart

C. Additional co-processors or modules may be necessary and shall be furnished as required to meet the functions specified herein and in Section 40 61 96 – Process Control Descriptions.

D. PLC processors shall be provided with substantial user program, data and logic memory to allow for future expansion of the overall system. The total memory used on each processor shall be less than 60% of available memory at project completion.

## 2.03 COMMUNICATIONS

A. PLC communications shall be provided as specified in Section 40 66 00 – Network and Communication Equipment and as shown on the Control System Architecture Drawing.

B. In addition to a communications port for the control system network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

C. The PLC shall be able to support various types of fieldbus communication systems for data links to field instruments (where specified) in addition to connected equipment such as power monitors, VFDs, motor protection monitors, etc. As a minimum, Profibus DP, Foundation Fieldbus, Modbus RTU Master and Slave, TCP/IP Ethernet shall be supported. The Contractor shall coordinate the efforts of the necessary parties (instrumentation and control system subcontractor and equipment suppliers) to

accomplish the required device and data table addressing between each PLC and the associated connected equipment.

D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract and shall be supplied at no extra cost to the Owner.

## 2.04 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules in associated I/O backplane/chassis or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC or 120 VAC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 40 61 23 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 40 78 00 – Panel Mounted Instruments. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 16-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15 degrees Celsius and be capable of accepting signals from 100-ohm Platinum RTDs. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC, 4-20mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 40 78 56 – Isolators, Intrinsically-Safe Barriers, and Surge Suppressors. Maximum density for analog I/O modules shall be eight per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or

at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

## 2.05 REMOTE I/O SUBSYSTEMS

A. Remote I/O shall be provided as designated on the Control System Architecture Drawing. Remote I/O shall be either PLC backplane type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Article 2.04 – Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.

B. Remote I/O shall communicate with the PLC using the PLC manufacturer’s standard protocol or an open standard network such as DeviceNet, Ethernet IP, ProfiNet, Foundation Fieldbus, Modbus TCP/IP, or equal.

## 2.06 INPUT/OUTPUT CIRCUIT ARRANGEMENT

A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

## 2.07 PROGRAMMING SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest, full-featured version, Windows-based, and shall be fully compliant with IEC 61131-3 standards. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. PLC programming software shall include documentation on optical media.

B. A minimum of one copy of the PLC programming software shall be purchased by the instrumentation and control system subcontractor and registered to the Owner.

C. If available, the configuration and programming software shall support communication over the network specified in Section 40 66 00 – Network and Communication Equipment to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the existing HMI Server operator workstations. All necessary hardware required to have the operator workstation perform PLC configuration and programming shall be provided.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. PLC programming shall be furnished to perform all functions described in Section 40 61 96 – Process Control Descriptions, including global functions. In addition, PLCs shall be programmed to provide additional functions described in other Sections of this Division.

B. PLC programming shall make use of the various IEC languages as appropriate to the specific task and shall be performed in a modular style making extensive use of program blocks (subroutines) and program variables to be passed to the program blocks for specific equipment. It is the intent of this requirement to allow for enhanced readability and ease of modification of the program code through the elimination of multiple instances of repeated code for the same function in a “hard-coded” style.

C. Extensive comments shall be placed in the program code to describe the functions of all elements of the program code. PLC code that does not contain comments shall be rejected.

D. Refer to Section 40 61 13 – Process Control System General Provisions, Part 3 for additional requirements.

### 3.02 REQUIREMENTS FOR MANUFACTURER-SUPPLIED PLCS

A. PLCs that are supplied for equipment local control panels by individual equipment manufacturers or suppliers shall, where so indicated on the Control System Architecture Drawing, be integrated into the plant control system. The manufacturer-supplied PLC shall be furnished, installed and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the main control system at the plant.

B. Where required as described above, each manufacturer-supplied PLC shall be connected to the Ethernet process control network for access from the plant control system HMI servers, as specified in Section 40 66 00 – Network and Communication

Equipment, and shall contain a fiber optic Ethernet switch identical to those provided for the rest of the network-connected PLCs.

C. Each equipment manufacturer shall provide all monitoring and control data to be transferred between the PLC and the plant control system in contiguous blocks of PLC registers to facilitate block read and write commands for efficient scanning by the control system SCADA servers. These contiguous registers shall be arranged in a single data transfer area, which shall be divided into eight distinct areas with an emphasis on flexibility and future expansion. The distinct areas shall be arranged by data type (analog or discrete), transfer direction (server to PLC or PLC to server), and, where applicable, implementation schedule (current or future). Where required, peer-to-peer communication between PLCs shall likewise be accomplished using separate blocks of contiguous registers. Where individual equipment PLCs are not required to be connected to the plant control system via the data highway network, they shall provide the individual hardwired signals as specified in the Contract Documents. Data and commands for connection to the control system are described in the Drawings, the Input/Output Schedule, the individual equipment Specification Sections, and in Section 40 61 96 – Process Control Descriptions.

D. The operator interface for control of each individual system shall be performed by local operator interface units or individual pilot devices on the equipment local control panel, as specified in the associated equipment Specification Section. Additional operator interface functions shall be provided through the plant control system as specified in the respective equipment specifications and in Section 40 61 96 – Process Control Descriptions.

E. Where operator interface and control functions are required to be provided through the plant control system, the individual system supplier shall be responsible for coordination with the instrumentation and control system subcontractor to provide a complete and working equipment control system. The individual equipment supplier shall also be responsible for limiting the access of the plant control system to the equipment PLC code so as to prevent malfunctions of the equipment and any failure to continuously perform its intended functions. The equipment supplier shall be responsible for ensuring that no actions by the plant control system can damage or otherwise adversely affect the operation of the associated equipment or the safety of personnel working on or near that equipment. The equipment supplier shall also provide direction in the configuration of the SCADA software's security system by the instrumentation and control system subcontractor to limit access to the control functions of the equipment control system to authorized personnel only. The equipment supplier shall coordinate testing of the completed system with the instrumentation and control system subcontractor, which shall conform to the requirements of Section 40 61 21.72 – Field Testing.

F. The Contractor, equipment supplier and instrumentation and control system subcontractor shall coordinate testing and startup of the equipment provided by the

equipment supplier with the plant control system, including but not limited to the following tasks:

1. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.

2. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the instrumentation and control system subcontractor and equipment manufacturer personnel to perform loop checks simultaneously, as directed by the Engineer.

3. Coordinate and assist as needed to maintain I/O connectivity throughout the system.

4. Ensure personnel safety while equipment is exercised via the plant control system.

5. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the plant control system.

6. Provide temporary modifications to field devices and their terminations, if needed.

7. Providing labor and supervision, which may include, but is not limited to, the following: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about process startup and operation.

8. Operation of process equipment for verification of each plant control system input and output.

**END OF SECTION**

## SECTION 40 66 00
## NETWORK AND COMMUNICATION EQUIPMENT

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation IEEE 802.3 ethernet local area network(s) for communications among plant devices.

B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 63 43 – Programmable Logic Controllers

### 1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. A termination tool kit shall be provided containing all required tools and consumables for up to 25 connections of each connection type furnished. Termination kit shall be as manufactured by Black Box, Corning Cable Systems, Optical Cable Corporation, or equal.

2. One spare switch of each type furnished under this Contract.

### 1.04 SUBMITTALS

1. Fiber optic testing results, including signal attenuation for each fiber

### PART 2 – PRODUCTS

### 2.01 LOCAL AREA NETWORK (LAN)

A. An IEEE 802.3 ethernet local area network shall be used for communications between plant devices.

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B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links

extended outside of a building, unless specifically noted. Cables shall be as specified herein.

C. The Contractor may provide a network configuration different from that shown in the Contract Drawings with written approval of the Engineer, but the Contractor shall coordinate with all affected trades and pay for all additional charges incurred.

D. The Contractor shall provide appurtenances, including but not limited to, all hardware, cables, connectors, adapters, modules, and software, to implement a network as required for a fully functional system even if not explicitly specified or shown.

## 2.02 INDUSTRIAL ETHERNET NETWORK SWITCHES

A. Except where specifically allowed on the Control System Architecture Drawing, industrial ethernet network switches shall be provided for each device connected to the process control system network. The switches shall create switched ethernet networks that conform to the IEEE 802.3 and 802.3u standards using copper wires or optical fibers in a bus, tree or ring network topology as shown on the Drawings. Ethernet network switches shall be modular, rack mounted, or standard DIN-rail mounted within the PLC cabinet or in an adjacent communication cabinet, as shown on the Drawings.

B. Ethernet network switches shall support ring, bus, star, or point-to-point network topologies. On-line signal monitoring shall be provided to detect and locate impending faults. Ethernet network switches shall be replaceable on-line without disrupting the network. The ethernet network switches shall be integrated into the in-plant Ethernet network to form a redundant ring network with self-healing communication recovery. Switches shall support the non-proprietary Media Redundancy Protocol (MRP) and Rapid Spanning Tree Protocol (RSTP) in addition to the switch manufacturer’s standard redundant ring network protocol, all of which shall provide self-healing communication recovery.

C. Ethernet network switches shall meet the following minimum performance requirements:

1. Functions: Modular managed switch with store and forward switching mode, 10 Mbps ethernet, or 100 Mbps Fast-Ethernet, or gigabit Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable.

2. Management: Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.

3. Power Requirements: Redundant 24 VDC power supply

4. Operating Temperature: 0 to 60 degrees Celsius

5. Relative Humidity: 10 to 95%

6. Network Size: Up to 50 nodes in ring structure; otherwise unlimited

7. Port Type & Quantity (at each PLC location): minimum of four 10/100Base-TX, twisted pair cable, RJ-45 sockets, 0 to 100 meters LAN segment and two 100/1000Base-FX, multimode fiber optic cables (62.5/125 µm), LC, ST or SC sockets, 0 to 5,000 meters LAN segment

8. Link Budget: 8 dB @ 1300 nm; 10 dB @ 850 nm

9. Wavelength: 850 or 1300 nm

D. Acceptable industrial ethernet network switches shall be as manufactured by Cisco Systems, Hirschmann, Phoenix Contact, Weidmuller, or equal.

## 2.03 FIBER OPTIC MEDIA CONVERTERS

A. Fiber optic media converters shall be provided to transform the specific PLC network communications protocol into an optical signal suitable for transmission over the fiber optic cable specified herein. Fiber optic media converters shall be modular, rack mounted, or mounted within the PLC rack.

B. Fiber optic media converters shall meet the following minimum performance requirements:

1. Input Power: 110/220VAC or 24VDC, as required to match power source.

2. Operating Temperature: 0 to 60 degrees Celsius

3. Node-to-Node Distance: 6,500 feet

4. Nominal Wavelengths

a. 850 and 1300 nm for multimode fiber

b. 1310 and 1550 nm for single-mode fiber

5. Connector Type: SC, LC, or ST

C. The PLC manufacturer's standard, PLC rack-mounted fiber optic transceiver may also be used, subject to approval by the Engineer.

D. Port speed and duplex auto-negotiation shall be configurable.

E. Acceptable fiber optic media converters shall be as manufactured by Black Box, Phoenix Contact, or equal.

## 2.04 UNSHIELDED TWISTED PAIR CABLE

A. Unshielded twisted pair cable for drops within buildings shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 (i.e., Cat6) specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equal. Connectors shall be modular RJ-45 plug.

B. Solid conductors shall be used for all field wiring and punch-down applications. For patch cable applications and where installed-flexibility is necessary, such as for movable equipment or across enclosure door hinges, conductors shall be stranded.

C. For use as ethernet, Contractor's conduit/cable routing shall be limited to the maximum ethernet length of 100m. If this cannot be accomplished, Contractor shall design and provide a system utilizing long-range copper extenders or fiber with media conversion or similar to overcome distance limitations, subject to Engineer's approval.

D. Provide copper patch panels where more than one copper communication cable leaves the enclosure.

## 2.05 MULTIMODE FIBER OPTIC CABLE (OM1)

A. Fiber optic cable shall conform to TIA 492-AAAA and the following specifications:

1. Fiber Type: Graded Index (GI) Multimode
2. Fiber/Cladding Diameter: 62.5/125 microns
3. No. Fibers: 12 (color-coded), unless otherwise indicated
4. Cable Construction: Loose Tube w/ Ripcords
5. Filling: Water Swellable Dry Block
6. Armored: No
7. Central Member: Dielectric (Kevlar)
8. Rating: Gigabit ethernet, unless otherwise indicated
9. Modal bandwidth (OM1):
    a. 200 MHz*km OFL at 850 nm
    b. 500 Mhz*km OFL at 500 nm

10. Maximum Attenuation

    a. 3.5 dB/km at 850 nm

    b. 1.5 dB/km at 1300 nm

11. Application Type: Direct-burial/Conduit/Aerial

12. Plenum Rated: Where required (e.g., in drop ceilings)

13. Sheath: UV Resistant

14. Max. Tensile Load: 600 lb (2700 N) installation; 200 lb (890 N) long term

15. Minimum Bend Radius: 7 inches under maximum tensile load; 4.6 inches unloaded (installed)

16. Operating Temperature: -40 to 70 degrees Celsius

17. Operating Relative Humidity: 0 to 100%

B. Fiber optic cable shall utilize mechanically spliced, field installable, SC, LC, or ST compatible connectors. Connections shall have a typical loss of 0.35 dB or better and shall provide stable optical performance after numerous rematings. Heat or UV cured connections shall not be acceptable. Where applicable, field terminations shall use a simple procedure requiring minimal training.

C. Upon entering a cabinet, panel or console, loose tube fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. All individual fibers shall be terminated and all connections shall be tested. Tight buffered cable shall then be routed to the individual destinations as needed (or loose tube cable for runs to other buildings). Cabinet-mounted patch panels shall be Cabinet-Mounted Interconnect Center (C-MIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

D. Where cable is required to be routed to numerous, separate destinations within a building, loose tube cable shall be broken out immediately upon entering the building, all individual fibers terminated in a patch panel, and tight buffered, plenum rated cable shall be routed to the individual destinations. Building patch panels shall be Wall-Mountable Interconnect Center (WIC) or Premises Interconnect Center (PIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

E. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

F. Fiber optic cable shall be ALTOS All Dielectric Loose Tube Optical Cable as manufactured by Corning Cable Systems, the Extended Performance Fiber Optic Cable Series as manufactured by Phoenix Digital, Inc., Belden equivalent, equivalent system by Optical Cable Corporation, or equal.

## 2.06 FIBER OPTIC PATCH PANELS

A. Upon entering a cabinet, panel or console, fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. Fan-out kit shall provide mechanical connection to fiber optic cable jacket for strain relief and clean appearance. Where mechanical connection is not made or fan-out kit does not completely cover jacket, rip cords, dry block, material etc., fan-out kit shall be reinforced with short length of properly sized heat shrink tubing. Use of adhesive tape in this application shall not be permitted.

B. All fiber optic patch panels shall be mounted within a rack or a NEMA rated enclosure. Wall-mounting stand-alone patch panels shall not be permitted unless otherwise indicated.

C. Rack-mounted patch panels shall be Cabinet-Mounted Interconnect Center (C-MIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

D. Stand-alone patch panels shall be Wall-Mountable Interconnect Center (WIC) or Premises Interconnect Center (PIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

E. Fiber optic patch cable shall be provided at necessary lengths with a modal bandwidth (OM or OS) rating at least as high as the connected components.

# PART 3 – EXECUTION

## 3.01 GENERAL REQUIREMENTS

A. The destination of all network data cables (both copper and fiber) leaving an enclosure, patch panel, or building shall be labeled at each end using industry-standard wire markers.

B. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

## 3.02 FIBER OPTIC CABLE

A. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

B. Fiber optic cable shall be installed in accordance with cable manufacturer's instructions.

C. Testing

1. Bulk fiber shall be tested on-site to prior to installation to provide a reference for the installed test data.

2. All individual fibers, including spares, shall be terminated and all connections shall be tested after installation.

3. Complete installed fiber optic cable shall be tested for continuity with a visual fault locator or fiber tracer and the connections verified and documented. Cabling shall also be tested for optical/insertion loss in compliance with Tier 1 testing per TIA-568.

4. Submit all test results.

## 3.03 FIBER OPTIC PATCH PANELS

A. All patch panels shall be labeled with destination/function of each port, matching terminology from the Contract Documents where possible. Provide printed directory mounted to or adjacent to patch panel with this information where sufficient space is not available.

**END OF SECTION**

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## SECTION 40 67 00
## CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place, in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

C. Either manufacturer’s standard or custom enclosures may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.

D. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and field inspect new and existing structures as required to determine installation requirements and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

E. The terms enclosure, cabinet, and panel shall be considered the same product and are used interchangeably.

### 1.02 SUBMITTALS

A. Submittals shall be per Section 40 61 15 – Process Control System Submittals.

B. Thermal calculations.

C. Proof of circuit breaker selective coordination.

### 1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Computer System Hardware and Ancillaries

C. Section 40 78 00 – Panel Mounted Instruments

D. Section 40 78 56 – Isolators, Intrinsically-Safe Barriers, and Surge Suppressors

E. Section 40 70 00 – Instrumentation for Process Systems

F. Refer to Division 26 for additional requirements for conductors, circuit breakers, disconnect switches, etc.

## 1.04 PANEL LOCATION AND TYPE

A. For locations inside buildings in areas other than climate controlled (i.e., heated and air conditioned) electrical or control rooms, panel shall be Type 316 stainless steel NEMA 4X construction, or as indicated for hazardous area classification (Class, Division, at a minimum), or submersible, NEMA 6, applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications.

B. For locations in storage/feed areas for chlorine or other applicable corrosive chemicals, panel shall be of non-metallic construction, rated NEMA 4X, and be fully compatible with the associated chemical.

C. For locations within climate controlled (i.e., heated and air-conditioned) electrical or control rooms, panel shall be a painted steel fully enclosed NEMA 12 units with gasketed doors.

D. For outdoor locations, panel shall be Type 316L stainless steel NEMA 4X construction unless located in chlorine environments. Chlorine environment shall be nonmetallic NEMA 4X construction.

## 1.05 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies and Spare Parts, General.

# PART 2 – PRODUCTS

## 2.01 CABINETS AND PANELS

A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.

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B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.

C. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Doors for NEMA 4X cabinets shall be all stainless steel with three-point latches. Door hardware on NEMA 4X cabinets located in chemical storage/feed areas shall be non-corrosive in that environment.

D. Panels and cabinets located outside fence-secured areas shall be fitted with padlockable latch kits. Coordinate keying with Owner.

E. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.

F. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC) shall be provided with a folding laptop programmer shelf on the inside of the door. When deployed, the laptop shelf shall not be greater than 48 inches above finished floor. Laptop shelf shall be fitted to door with factory applied weld-studs. Weld discoloration and enclosure penetrations will not be accepted.

G. Unless otherwise noted, panel-mounted control devices (OIUs, hand switches, etc.) requiring operator access shall be mounted between 48 and 60 inches above the floor or work platform.

H. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Saginaw Control and Engineering (SCE). The Contractor may optionally provide cabinets that are custom-fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

## 2.02 FIELD PANELS

A. Field panels for outdoor service shall be suitable for wall or pipe mounting. Panels shall have the following features:

1. Hinged and foamed-in-place continuous gasketed door(s). Door material shall match enclosure and shall have piano hinge(s) and three-point latches.

2. Field panels located outside fence-secured areas shall be fitted with staple and hasp. Provide padlock and coordinate keying with Owner.

3. Thermal insulation and thermostatically controlled space heaters where required to prevent condensation or maintain environmental conditions for installed components.

4. External sun shields or shades constructed of the same materials as the associated enclosure, unless otherwise specified. Sun shield or shade shall be fitted to enclosure supports and not to enclosure. Sun shield or shade shall have a slightly sloped top to shed water and shall extend past the front of the enclosure by at least 6 inches and extend down the side and back of enclosure.

B. All external sample/process piping, including valves and appurtenances, shall be insulated with weather-proof insulation and heat-taped to prevent freezing. Heat taping shall be thermostatically controlled and self-regulating, and shall adjust its heat output to the temperature of the lines. Heat tape shall be powered from an equipment-safety GFCI circuit from within panel, unless otherwise shown or specified.

C. Field panels shall be adequately sized to house instruments, power supplies, surge protection, and appurtenant equipment required for operation. Sufficient space shall be provided for servicing instruments without removal of equipment from the enclosure.

D. Field panels shall be as manufactured by Hoffman, Saginaw Control & Engineering (SCE), or equal.

## 2.03 CABINET AIR CONDITIONING UNITS

A. Where indicated or required due to ambient conditions and panel component ratings, panel-mounted closed loop air conditioning units and thermostatically controlled space heaters shall be provided.

B. Air conditioning units shall both cool and dehumidify the cabinet's internal air. Each air conditioner shall be sized to handle current and future (with specified spare capacity filled) heat loadings from all equipment mounted inside the cabinet.

C. Air conditioners shall be provided with thermostats which operate the centrifugal evaporator blowers continuously to prevent stratification of air within the cabinet. Compressors shall operate as needed to maintain the temperature set at the thermostat. Compressors shall be provided with space heaters to maintain the compressor at a minimum temperature during cold ambient temperatures.

D. Ambient air shall be completely separated from the air inside the cabinet. All air conditioner components exposed to the atmosphere outside the cabinets shall be coated to prevent corrosion.

E. Power supply shall be 115VAC, 60 Hz. Units shall be provided with EMI/RFI noise suppressors.

F. Air conditioner enclosures shall be constructed of stainless steel or cold rolled steel which is phosphatized and finished in baked enamel.

G. Cabinet air conditioners shall be ProAir CR Series as manufactured by McLean Midwest of Brooklyn Park, MN, or equal.

## 2.04 TERMINAL BLOCKS

A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Weidmuller, Wieland, Square D, or equal.

B. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

## 2.05 NAMEPLATES

A. Items of equipment installed in control panels shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.

C. Nameplates shall be attached to metal equipment by NEMA rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.

D. Submit sample nameplate of each type.

# PART 3 – EXECUTION

## 3.01 FABRICATION

A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without

removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.

B. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.

C. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:

1. For NEMA 12 cabinets only, louvered openings near the bottom and top or thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet. Air velocities through the enclosure shall be minimized to assure quiet operation.

2. Thermostatically controlled, low noise internal air blowers to circulate air within the enclosure, maintaining a uniform internal temperature. Initial setpoint shall be 75 degrees F.

3. All intake openings in cabinets and panels shall be fitted with dust filters.

D. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.

E. The temperature inside each enclosure containing digital hardware (e.g., PLC, computer, Ethernet switch) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature. This thermostat shall be independent and separate from the thermostat used to control the temperature in the enclosure described above. Enclosure “high interior temperature” alarm shall be displayed on the HMI or OIT.

F. Intrusion alarm switches shall be provided on all enclosures containing digital hardware and shall generate an alarm to the nearest PLC when any enclosure door is opened. If panel contains a service light, alarm switch shall also be wired to turn light on when door is opened.

G. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.

H. Wiring within cabinets, panels, and consoles shall be installed neatly and shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 26 – Electrical of the Specifications, except that the minimum wire size for discrete signal wiring may be 16 AWG, and for analog wiring may be 18 AWG. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.

I. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.

J. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring when operating at differing voltages.

K. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.

L. All installed spare I/O hardware shall be wired along with live I/O wiring to the field wiring terminal blocks within the cabinet. Where space for spare I/O modules has been provided with the PLC backplane or DIN-rail mounting system, corresponding space for wiring, surge protection, and terminations shall be furnished within the cabinet.

M. A copper ground bus shall be installed in each cabinet and shall be connected to the building power ground.

N. Interior panel wiring shall be tagged at all terminations with machine-printed self-laminating labels. Labeling system shall be Brady TLS 2200 Printer with TLS 2200®/TLS PC Link™ labels, or equivalent system by Seton or Panduit. The wire numbering system and identification tags shall be as specified in Section 26 05 19 – Low-Voltage Conductors and Cables. Field wiring terminating in panels shall be labeled in accordance with the requirements of Section 26 05 19 – Low-Voltage Conductors and Cables. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

O. Wires shall be color coded as follows:

1. Equipment Ground – GREEN

2. 120 VAC Power – BLACK

3. 120 VAC Power Neutral – WHITE

4. 120 VAC Control (Internally Powered) – RED

5. 120 VAC Control (Externally Powered) – YELLOW

6. 24 VAC Control – ORANGE

7. DC Power (+) – RED

8. DC Power (-) – BLACK

9. DC Control – BLUE

10. Analog Signal – BLACK/WHITE or BLACK/RED

P. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a circuit will trip only its immediate breaker and not the upstream breaker.

Q. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and LED service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.

R. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power." Letters in the word "WARNING" shall be 0.75 inch high, white.

S. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

## 3.02 PAINTING/FINISHING

A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 09 for additional requirements.

B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.

C. Panels fabricated from stainless steel shall not be painted.

D. Panels fabricated from non-metallic materials (e.g., FRP) shall be gel-coated and shall not be otherwise painted.

## 3.03 INSTALLATION

A. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

**END OF SECTION**

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# SECTION 40 67 63
# UNINTERRUPTIBLE POWER SYSTEMS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. One UPS shall be provided for each operator workstation and its peripherals (i.e. printer, network equipment, radio, etc.) provided under this Contract.

C. One UPS shall be provided for each programmable logic controller (PLC) panel or remote telemetry unit (RTU) and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC and RTU cabinets shall not be powered by the UPS.

D. UPS units shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:

1. UPS units for operator's consoles shall be mounted within the consoles.

2. UPS units for control panels containing PLCs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.

3. UPS units for RTUs shall be mounted within the RTU cabinet.

E. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 40 67 00 – Control System Equipment Panels and Racks and its subordinate Sections.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Computer System Hardware and Ancillaries

C. Section 40 63 43 – Programmable Logic Controllers

### 1.03 SUBMITTALS

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A. Sizing calculations, in Watts (W) or Volt-Amps (VA), for all UPS units.

B. Heat dissipation calculations for all enclosures that contain a UPS unit.

C. Run time calculation.

## PART 2 – EQUIPMENT

### 2.01 UNINTERRUPTIBLE POWER SYSTEMS

A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.

B. UPS units shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.

C. An automatic bypass switch shall be provided with UPS units of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.

D. A manually operated maintenance bypass switch shall be provided for each UPS installation, other than for computers, to allow the hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the load.

E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/RTU.

F. Each UPS shall meet the following requirements:

1. Input voltage shall be 117 VAC, single phase, 60 Hz.

2. Voltage regulation shall be +/-5 percent for line and load changes.

3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.

4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a

minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.

5. The UPS capacity shall be sized for 150% of the connected load.

6. A status monitoring and control panel shall be provided and shall include the following:

   a. Status indicating lights for both normal and abnormal conditions.

   b. Individual alarm contacts that shall close upon:

      1) Loss of the AC line

      2) Low battery level

      3) Fault condition

   c. Contacts shall be wired to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.

   d. Circuit breaker for the AC input

7. Sound absorbing enclosure

8. EMI/RF noise filtering

9. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.

G. UPS systems shall be the 9PX series by Eaton, Smart-UPS On-line series by APC/Schneider-Electric, or equal.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. Where the UPS is mounted within the PLC or RTU cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted PLC cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.

B. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

**END OF SECTION**

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# SECTION 40 68 00.13
# PROCESS CONTROL SOFTWARE (MODIFY EXISTING)

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place in satisfactory operation all control and information system software with all required programming and software appurtenances as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 93 – Process Control System Input/Output List

C. Section 40 61 96 – Process Control Descriptions

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 OVERALL SYSTEM CONFIGURATION

A. The Owner's existing human machine interface (HMI) software, including but not limited to all relevant displays, alarm summary pages, data collection, and historical trending/reporting, shall be modified to include all work performed under this Contract. The existing software is National Instruments (NI) Lookout, Version 6.7.1.

B. The Owner's existing control system shall be modified to include the inputs and outputs specified in the Input/Output Schedule and in other Sections of this Division.

### 3.02 SOFTWARE MODIFICATIONS

A. All HMI software configuration performed under this Contract shall be coordinated with the Owner and shall match in all possible respects the "look and feel," in the opinion of the Engineer, of the existing SCADA System. Specified features and functions of this Contract that do not already exist, even if only for "look and feel," shall be provided. Details on how to best implement these features and functions shall be discussed with Owner and Engineer.

B. Major HMI software scope of work shall include, but shall not be limited to, the following:

1. Create new graphic displays showing the new facilities and functions described herein complete with all associated equipment and instrumentation.

2. Modify the existing plant overview display(s) for the SCADA system to include the new facilities and equipment, and create links to the new screens.

3. Modify existing alarm summary pages to incorporate new monitoring data into the alarm displays.

4. Modify existing reports to include the additional monitoring points specified under this Contract.

5. Create new real-time and historical trends, and coordinate with the Owner appropriate grouping of the trend charts.

6. Update the system status display to include new hardware provided under this Contract.

C. Ladder logic resident in existing PLCs shall be modified to perform the functions described as specified herein and in Section 40 61 96 – Process Control Descriptions. Specifically, the existing PLCs shall be programmed to accept the I/O specified in Section 40 61 93 – Process Control System Input/Output List and to make this data readily available on the plant network and shall be programmed to execute the logic necessary to implement all control functions associated with the scope of work specified under this Contract.

D. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. The HMI software shall not be used for this purpose.

**END OF SECTION**

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# SECTION 40 70 00
# INSTRUMENTATION FOR PROCESS SYSTEMS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The instrumentation and control system subcontractor shall furnish, install, test and place in operation instruments as scheduled together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with the process control system as shown on the Drawings and as specified. The Contractor may elect to install sensors on process lines provided that the instrumentation and control system subcontractor provides full on-site supervision during installation. Mounting of associated indicators, sensors, sampling pumps, power supplies, brackets and appurtenances shall be provided as indicated.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation and control system subcontractor shall supervise installation of equipment provided where installation is by other Subcontractors or contractors.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instruments are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 05 – Metals

B. Section 40 61 13 – Process Control System General Provisions

C. Section 40 61 91 – Process Control System Instrument List

D. Section 40 67 00 – Control System Equipment Panels and Racks

E. Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings

F. Section 40 61 22 – Tools, Supplies, and Spare Parts, General

G. Instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

## 1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 -- Tools, Supplies, and Spare Parts, General.

B. Additional items as recommended by the analytical instrument manufacturers or as described for the specified analytical instrument sections shall be provided.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

B. Equipment installed in a hazardous area shall meet or exceed Class, Group, and Division requirements as shown on the Drawings, to comply with the National Electrical Code.

C. All field instrumentation for outdoor service shall be provided with enclosures that are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.

2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 40 67 00 – Control System Equipment Panels and Racks, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.

D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

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E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Paragraph 3.01 B herein. All indicator readouts shall be linear in process units. Readouts of 0 to 100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.

F. Unless otherwise specified, field instrument and power supply enclosures shall be Type 316 stainless steel, fiberglass (or similar, per Engineer's judgement) or PVC coated copper-free cast aluminum NEMA 4X construction.

G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for long term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

I. All devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117V, +/-10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

K. All analog transmitter and controller outputs shall be isolated, 4-20mA into a load of 0 to 750 ohms, unless specifically noted otherwise. All switches shall have double pole, double throw contacts rated at a minimum of 600 VA, unless specified otherwise.

L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

## 2.02 ANALYTICAL INSTRUMENTATION

A. Liquid samples shall not pass through housings containing analyzer electronics. Process fluid temperature will be within a range of 40 to 90 degrees F.

B. Where ambient temperatures will affect accuracy by more than 1 percent of span, a suitable isothermal enclosure with thermostatically controlled space heater shall be provided.

C. Sample assemblies shall be suitable for submersion or flow-through service as noted and shall be chemically inert to constituents of raw wastewater solids or other chemical environment, as scheduled. Where the sample is drawn prior to filtration, the sample assemblies shall be capable of handling solids and grease.

D. Each analyzer requiring reagents or other replaceable parts shall be furnished with sufficient chemicals and replaceable parts for startup and acceptance tests and the specified warranty period.

E. Contractor's submittals on these analyzers shall include information on monthly reagent consumption and a list of replaceable parts required for periodic maintenance and the recommended operating periods between replacements. Installation of analyzers and sample preparation shall be in accordance with the analyzer manufacturer's instructions.

F. Analysis instrumentation performance, accuracy and reproducibility shall be as prescribed in APHA/AWWA/WEF "Standard Methods for the Examination of Water and Wastewater", latest edition. For those measurements specified herein, for which performance characteristics are not listed in the above, the supplier shall state instrument performance characteristics. The "referee" method shall be as prescribed in EPA Methods for Chemical Analysis of Water and Wastes (1971).

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. General

1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation and control system subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole and shall supervise the installation of process instrumentation supplied under this Division.

2. Work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, the latest version of the API Recommended Practice (RP) 551 manual shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two inch diameter pipe stands welded to a 10-inch-square by 1/2-inch-thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or Type 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2 inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.

2. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B 36.19, with stainless steel blind flange for equipment mounting, unless otherwise indicated.

3. Materials for miscellaneous mounting brackets and supports shall be Type 316 stainless steel construction.

4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 05 – Metals of the Specifications.

5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

## 3.02 ADJUSTMENT AND CLEANING

A. The instrumentation and control system subcontractor shall comply with the requirements of Division 01 – General Requirements of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his/her designated representative(s), reserves the right to witness any test, inspection, calibration or start up activity. Acceptance by the Engineer of plans, reports, or documentation relating to testing or commissioning activity shall not relieve the Contractor of his/her responsibility for meeting all specified requirements.

B. The instrumentation and control system subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Instruments which fails to meet Contract requirements, or published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel,

equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description of the installation test(s) to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

D. Field instrument calibration shall conform to the following requirements:

1. The instrumentation and control system subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate or verify factory calibration of each instrument supplied under this Contract and existing instruments shown to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration. Calibration and verification shall take place under actual process conditions. Forcing outputs shall not be acceptable.

2. Each instrument shall be calibrated/verified at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy’s as set forth by NIST.

3. The instrumentation and control system subcontractor shall provide a written calibration/verification sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, brief description of how the calibration process was performed, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made. For electronic or powered instruments, the calibration/verification sheet shall also list all configurable parameters that have been modified from their default factory setting.

4. If doubt exists as to the correct method for calibrating or checking the calibration/verification of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.

5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to adjustments, sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and

excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to over-voltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and re-calibrated/verified at no cost to the Owner. Equipment that has been adjusted, modified, or moved or there is evidence of such activity shall be re-calibrated/verified at no cost to the Owner.

6. After completion of instrumentation installation, the instrumentation and control system subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

**END OF SECTION**

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## SECTION 40 71 79.16

## FLOW SWITCHES (THERMAL)

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the thermal dispersion flow switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. Contractor shall be responsible for coordinating process line size to match capabilities of the selected instrument. In consultation with Engineer, small diameter line sizes shall be increased in size as required to meet velocity requirements of the instrument. At no additional cost, provide reducers and increase process line size in the same material in a straight segment of pipe for a length no less than manufacturer's recommended length of straight run.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

### PART 2 – PRODUCTS

### 2.01 THERMAL DISPERSION FLOW SWITCHES – INSERTION TYPE

A. Each flow switch shall utilize a thermal dispersion type, Type 316 stainless steel sensing element (probe), unless otherwise indicated, installed in the process piping as indicated on the Drawings. Probe style shall be as determined by the manufacturer and based on the specific application.

B. Unless otherwise indicated or recommended by the manufacturer, the element insertion length shall be approximately 1/3 to 1/2 of the pipe diameter plus allowance for mounting accessories. All mounting accessories shall be provided.

C. The electronics shall be mounted to the sensor, unless otherwise indicated. Power supply to the unit shall be 120VAC, 60 Hz. Where remote mounted, manufacturer shall furnish a continuous length of cable between the sensor and the electronics.

D. The instrument shall be housed in a NEMA 4X (IP66) enclosure and shall be rated for a Class I, Division 1 or Division 2 environment, per the Area Classification Drawings, when located in a hazardous area.

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E. The unit shall have field configurable dual SPDT or single DPDT relay contacts rated 6 amps at 115VAC for remote alarming.

F. Flow repeatability shall be +/-1 percent of setpoint range.

G. Flow response time shall be as low as 3 seconds.

H. The thermal dispersion flow switch shall be Fluid Components Model (FCI) FLT93 series, Sierra InnovaSwitch, Magnetrol Thermatel TD2 series, or equal.

## 2.02 THERMAL DISPERSION FLOW SWITCHES – INLINE TYPE

A. Each flow switch shall utilize a thermal dispersion type, Type 316 stainless steel sensing element (probe), unless otherwise indicated, factory installed in a 1-inch NPT Type 316 stainless steel tee, unless otherwise indicated. Probe style shall be as determined by the manufacturer and based on the specific application.

B. Unions shall be installed as required to permit removal of the flow switch without dismantling the piping system. Unions shall be constructed of Type 316 stainless steel, unless mounted in nonmetallic pipe. For nonmetallic pipe, union material shall match the nonmetallic pipe.

C. The electronics shall be mounted to the sensor, unless otherwise indicated. Power supply to the unit shall be 120VAC, 60 Hz. Where remote mounted, manufacturer shall furnish a continuous length of cable between the sensor and the electronics.

D. The instrument shall be housed in a NEMA 4X (IP66) enclosure and shall be rated for a Class I, Division 1 or Division 2 environment, per the Area Classification Drawings, when located in a hazardous area.

E. The unit shall have field configurable dual SPDT or single DPDT relay contacts rated 6 amps at 115VAC for remote alarming.

F. Flow repeatability shall be +/-1 percent of setpoint range.

G. Flow response time shall be as low as 3 seconds.

H. The thermal dispersion flow switch shall be Fluid Components Model FLT-93L series, Sierra InnovaSwitch, Magnetrol Thermatel TD2 with Mini-Sensor Probe, or equal.

# PART 3 – EXECUTION

## 3.01 REQUIREMENTS

A. All threaded connections between stainless steel components shall be installed with process compatible anti-seize lubricant to prevent galling.

B. Refer to Section 40 70 00 – Instrumentation for Process Systems, for additional information

**END OF SECTION**

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# SECTION 40 72 76.26
# LEVEL SWITCHES (FLOATS)

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the float level switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

## PART 2 – PRODUCTS

### 2.01 LEVEL SWITCHES (FLOATS)

A. Level switches of the direct acting, float-operated design shall be comprised of a hermetically sealed, approximately 5-inch-diameter plastic casing float, containing microswitches and flexibly supported by means of a heavy neoprene or PVC jacket, with three-conductor cable a minimum of 20 feet in length. Unless otherwise specified, media specific gravity is 0.95 to 1.05. Microswitches shall be one normally open and one normally closed, 5A, 115VAC capacity. Float hangers and supports shall be provided as shown on the installation detail Drawings.

B. Float switches shall be Model ENM as manufactured by Flygt or equal.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

**END OF SECTION**

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## SECTION 40 73 13
## PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

C. Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings

### PART 2 – PRODUCTS

### 2.01 PRESSURE GAUGES

A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed approximately 75% of the full-scale range.

C. Features

1. Mounting: ½” NPT, lower stem mount type

2. Accuracy: 0.5% full scale

3. Case: Solid front, black phenolic material

4. Dial: White background and black letters

5. Glass: Shatterproof

6. Blow-out protection: Back

7. Pressure element: stainless steel bourdon tube

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8. Movement: Stainless steel, Teflon coated pinion gear and segment

9. Gaskets: Buna-N

D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.

E. Gauge size shall be 4-1/2".

F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings.

G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.

H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

**END OF SECTION**

## SECTION 40 76 21
## SINGLE POINT GAS MONITORING SYSTEMS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the single point gas monitoring systems with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

### 1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. One spare sensor of each type used shall be furnished.

B. Calibration equipment as recommended by the manufacturer and a 1-year supply of calibration gas for each gas measured shall be provided to field calibrate the gas monitoring systems.

### PART 2 – PRODUCTS

### 2.01 GENERAL

A. Gas monitoring systems shall include a sensor to monitor specified gas and a microprocessor-based transmitter that is capable of accepting, converting and transmitting signals from the sensor. The complete gas monitoring system including sensor, transmitter, and accessory equipment shall be supplied by a single manufacturer. One system shall be provided per gas per location.

### 2.02 SENSORS

A. All sensors shall sample and monitor the atmosphere without the aid of pumps or other mechanical devices. Sensors and associated enclosures shall be classified as Class I, Division 1, Group C and D as specified by the NEC. Sensors shall be mounted with non-corrosive hardware as shown in the Drawings and/or as recommended by the manufacturer.

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1. Combustible Gas Sensor: The combustible gas sensor shall be the infrared (IR) type. It shall be immune to poisoning by hydrogen sulfide and silicone. The IR combustible sensor shall be capable of calibration without gas and shall be capable of performing a full calibration by zero adjustment only. The IR sensor shall allow detection of an above 100% LEL condition (over-range). The IR sensor shall not contain a flashback arrestor/frit.

2. Electrochemical (Toxic and Oxygen) Sensor: Sensors to detect toxic gases and oxygen shall be of the electrochemical type and shall not require the periodic addition of reagents.

B. Sensors shall be contained in sensor modules mounted externally to the main enclosure. All sensor modules shall have the capability of replacement while the unit is under power (hazardous areas) without the need for tools.

C. Sensor modules shall contain all relevant sensor information within the module so that the module may be calibrated off-site. This information shall include sensor manufacturer date, gas type, gas range, calibration data, and default relay parameters. The sensor module shall not require a battery or power source to store this data.

D. The sensor shall be capable of being mounted remotely from the transmitter. The allowable distance from the remote mounted sensor to the transmitter shall be a minimum of 100 feet. The enclosure for the combustible gas sensor shall be classified as Class I, Division 1, Groups A, B, C & D.

## 2.03 TRANSMITTER

A. The transmitter shall be classified as Class I, Division 1, Groups B, C & D. The transmitter shall have a digital readout to indicate the gas type being monitored and the concentration of gas present. The display shall sequentially show the gas type and gas concentration. The transmitter shall have normal, alarm, and fault indicating lights. Alarm level set points shall be adjustable by means of a handheld infrared controller.

B. Transmitters shall have the following specifications:

| Parameter | Value |
|---|---|
| Temperature Range | -40 to +60°C |
| Drift | Zero Drift: <5% per year<br>Span Drift: <10% per year |
| Accuracy | ±1% Full scale or 2 ppm, typical<br>±2% Full scale or 2 ppm, ($O_2$, CO)<br>±3% Full scale (<50% LEL combustibles)<br>±5% Full scale (>50% LEL combustibles)<br>±10% Full scale or 2 ppm (non-CO toxics) |

| Parameter | Value |
|---|---|
| Response Times | <12 sec, for 20% change (oxygen and toxics)<br><30 sec, for 50% change (oxygen and toxics)<br><8 sec, for 50% change (combustibles)<br><20 sec, for 90% change (combustibles) |
| Humidity | 15 to 95% relative humidity, non-condensing |
| Sensor Life | 2 years (oxygen and toxics)<br>3 years (combustibles) |
| Power | 90 to 130 VAC, 50 to 60 Hz (internal power supply) |
| Signal Output | 4-20mA 2-wire current sink<br>4-20mA 3-wire current source |
| Relay Contacts Rating | 5A @ 220VAC, 5A @ 30VDC |

C. Calibration shall be performed by a handheld infrared controller. It shall not be necessary to open the monitor enclosure to perform calibration or adjustment of the unit. With the exception of a monthly check and recalibrations, no periodic maintenance shall be necessary.

D. Gas monitoring systems shall be Ultima X Series as manufactured by MSA Instruments, equivalent by Draeger or Scott, or equal.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

**END OF SECTION**

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# SECTION 40 78 00
# PANEL MOUNTED INSTRUMENTS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the panel mounted instruments, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Control and Information System Hardware, General

C. Section 40 67 00 – Control System Equipment Panels and Racks

### 1.03 GENERAL INFORMATION AND DESCRIPTION

A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

### 1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts, General. In addition, the following specific spare parts items shall be provided:

1. One of each type of panel mounted equipment (i.e., indicators, signal converters, etc.) provided under this Contract.

2. Five of each type of interposing control relay provided under this Contract.

## PART 2 – PRODUCTS

### 2.01 OPERATORS

A. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant. For Hazardous areas, control operators shall be rated NEMA 7.

B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull

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release. Selector switches shall be non-illuminated, maintained contact type, unless otherwise indicated.

C. Pilot lights shall be of the proper control voltage, push-to-test LED type with lens and LED lamp colors as specified as follows:

1. Red: stopped, off, or closed

2. Green: running, on, or opened

3. Amber: fault, alarm, or warning

4. White: generic non-alarm status

5. Blue: control power on

D. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.

E. Control operators for all equipment under this Contract shall be of the same type and manufacturer unless otherwise indicated. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal

## 2.02 ELECTRONIC INDICATORS

A. Electronic indicators shall be 3.5- or 6-digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20mA current loop signal circuits. Indicator operating voltage shall be 115VAC 10%, 60 Hz. Indicator controls shall include three front-panel pushbuttons for modifying alarm values and other indicator setup. Two form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240VAC, resistive load. Where required, a regulated and isolated 24V excitation power supply shall be provided. Indicators shall be suitable for indoor or outdoor service as required and shall have the same NEMA enclosure rating as the associated enclosure.

B. Indicators shall be Red Lion Model IMP or APLCL, Precision Digital, or equal.

## 2.03 RELAYS

A. Interposing control relays (CR)

1. Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein.

2. Interposing relays shall be small format type, DPDT, minimum 10A, 120VAC contact rating.

3. Relay coils shall be 120VAC or 24VDC as required to interface with equipment.

4. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil.

5. Relays shall be as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.

B. Timing Relays (TR)

1. Timing relays shall be electronic type with 120VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays.

2. Timing relays shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, equivalent by Eaton/Cutler-Hammer, equivalent by Allen-Bradley, or equal.

## 2.04 TOTALIZERS

A. Totalizing counters shall be provided for flush panel, spring-clip mounting. Face dimensions of the totalizing counters shall be no larger than 1-1/8-inches high by 2-inches wide. Totalizing counters shall contain eight digits. Height of the digits shall not be less than 5/32-inch. Numerals shall be white on a black background. The counter shall be non-resettable and shall be totally compatible for operation on the pulses supplied by the associated instrument or integrator. The totalizing counter shall be capable of a maximum count rate of 25 counts/second.

B. Legend plates shall be provided for each of the totalizing counters with white letters on a black background with legends as specified below.

C. Totalizing counters shall be manufactured by Kessler-Ellis, or equal.

## 2.05 ALARM HORNS

A. Alarm horns shall be general-purpose type, panel-mounted, and shall be suitable for indoor or weatherproof service, as required. Power supply shall be either 115VAC or 24VDC. Horns shall be capable of producing 100 dB at 10 feet and shall have adjustable volume.

B. Horns shall be Vibratone series as manufactured by Federal Signal Corporation, McMaster-Carr equivalent, Edwards Signaling Company equivalent, or equal.

# PART 3 – EXECUTION

## 3.01 REQUIREMENTS

A. Refer to Section 40 67 00 – Control System Equipment Panels and Racks, for additional requirements.

**END OF SECTION**

## SECTION 40 78 56

## ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation the isolators, intrinsically safe barriers, and surge protection devices (SPDs) as specified herein and as shown on the Drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Control and Information System Hardware, General

C. Section 40 67 00 – Control System Equipment Panels and Racks

D. Section 40 78 00 – Panel Mounted Instruments

### 1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts, General.

B. In addition, the following specific spare parts items shall be provided:

1. Five of each type of SPD provided under this Contract.

### PART 2 – PRODUCTS

### 2.01 SURGE PROTECTION

A. General

1. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.

2. Manufacturer's Requirements: All SPDs shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, Weidmuller, or equal.

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3. SPD installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.

4. SPD shall be installed as close to the equipment to be protected as practically possible.

5. Device Locations: As a minimum, provide SPDs at the following locations:

    a. At connections between AC power and electrical/electronic equipment, including, but not limited to, panels, assemblies, and field mounted analog transmitters.

    b. At both ends of signal circuits that have any portion of the circuit extending outside of a building.

    c. At both ends of copper-based communication cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

    d. On all external telephone communication lines.

B. AC Power Protection

1. SPD assemblies for connections to AC power supply circuits shall:

    a. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.

    b. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The SPD shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.

    c. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events and shall have status indication lights.

    d. Comply with all requirements of UL 1449, latest edition.

    e. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

    f. Have the following characteristics:

        1) Maximum Continuous Operating Voltage: 150VAC

2) Maximum Operating Current: 20 amps

3) Ambient Temperature Range: -20 degrees C to +65 degrees C

4) Response Time: 5 nanoseconds

C. Analog signal circuit protection

1. SPD assemblies for analog signal circuits shall:

a. Have four lead devices with DIN Rail mounting.

b. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

c. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.

d. Comply with all requirements of UL 497B.

e. Be able to withstand a peak surge current of 10,000A based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

f. Limit line-to-line voltage to 40V on 24VDC circuits.

g. Have the following characteristics:

1) Maximum Continuous Operating Voltage: 28VDC

2) Ambient Temperature Range: -20 to +65 degrees C

3) Response Time (Line-to-Line): 5 ns

D. Communication Circuit Protection

1. SPDs for copper-based data communication circuits shall:

a. Be designed for the specific data communication media and protocol to be protected (e.g., telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF).

b. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:

1) IEC 60-1 / DIN VDE 0432 part 2

2) CCITT K17 / DIN VDE 0845 part 2

3) IEEE C62.31

c. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

d. Provide automatic recovery.

## 2.02 INTRINSICALLY SAFE BARRIERS AND RELAYS

A. Intrinsically safe relays and barriers shall be provided where required to interface with equipment located in Classified (i.e., hazardous) areas.

B. Intrinsically safe relays and barriers shall be FM approved.

C. Manufacturer shall be

1. Pepperl+Fuchs

2. Crouse Hinds

3. Square D

4. Or equal

## 2.03 ISOLATORS AND CONVERTERS

A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.

B. General Requirements

1. Converters shall be of the miniature type, utilizing all solid-state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided.

2. Power supply shall be 120V, 60 hertz where required by the converter, unless otherwise indicated.

3. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum.

4. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.

C. Current to Current (I/I) Isolators

1. Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance.

2. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

D. Voltage to Current (E/I) Transducers

1. Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4-20mADC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance.

2. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

E. Frequency to Current (F/I) Transducers

1. Frequency to current transducers shall convert pulse rate and pulse duration signals to 4-20mA, 24VDC analog signals. Converters shall include field adjustable input frequency range. Converter power shall be 120VAC, 60 Hz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines.

2. Transducers shall be Series 5100 as manufactured by AGM, or equivalent by Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

F. Current to Frequency (I/F) Transducers

1. Current to frequency transducers shall convert 4-20mA, 24VDC analog signals to pulse rate and pulse duration signals. Converters shall include field adjustable output frequency range. Converter power shall be 120VAC, 60 Hz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines.

2. Transducers shall be Series 5016 as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

G. Integrators

1. Integrators shall be provided as interchangeable plug in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be +0.1% of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid state output.

2. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

H. Electronic Switches (Alarm Relays)

1. Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4-20mADC, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2% of span. The set point stability shall be +0.1% per degree F. The repeatability shall be +0.1% of span. The units shall be furnished with SPDT relays rated at 10A at 115VAC.

2. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

I. RTD to Current Signal Converters

1. RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4-20mADC output signal. Accuracy shall be 0.10% of span or better. Calibrated span of each converter shall be as indicated on the instrument list. The Contractor shall coordinate calibration of the signal converters with existing RTD elements.

2. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. See Section 40 78 00 – Panel Instruments and Accessories, for additional requirements.

**END OF SECTION**

## SECTION 40 79 00

## MISCELLANEOUS INSTRUMENTS, VALVES, AND FITTINGS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation, the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.

B. Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This Specification shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

### 1.03 SUBMITTALS

A. Per Section 40 61 15 – Process Control System Submittals

B. Impulse piping layout and routing drawings

C. Complete instrument assembly drawings showing orientation to installed process piping.

### PART 2 – PRODUCTS

### 2.01 PROCESS TUBING

A. Process, impulse, or capillary tubing shall be 1/2 x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with 37 degrees Type 316 stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.

B. Piping for closely coupling instruments to process seals shall be standard stainless steel NPT threaded piping or NPT tapped mounting blocks.

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C. A nickel-based lubricant shall be used on threaded stainless steel piping connections to prevent galling.

## 2.02 POWER, CONTROL, AND SIGNAL CABLES

A. Power, control and signal wiring shall be provided under Division 26 of the Specifications, unless otherwise indicated.

## 2.03 CHEMICAL DIAPHRAGM SEALS

A. Diaphragm seals shall be provided for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, seals shall be of all 316 stainless steel construction. In general, diaphragms shall be 316L stainless steel for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, all components shall be non-reactive with the process fluid in all cases. Refer to the Process Control System Instrument Lists for specific materials requirements.

B. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries.

C. Seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equal.

## 2.04 ISOLATING RING SEALS

A. For solids bearing fluids, line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the associated pressure sensing instrument(s).

1. Full Line Size Isolating Ring Seals

a. Where indicated, the sensor body shall be full line size wafer design.

b. Full line size isolating ring seals shall have 316 stainless steel housing and assembly flanges and Buna N flexible cylinder lining for in line mounting. The wafer shall have through bolt holes or centerline gauge for positive alignment with the associated flanged piping. Gauge or readout shall be oriented for viewing.

c. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Manufacturer shall furnish seals with a quick-disconnect-type fitting for field disassembly and reassembly, however, seal and instruments shall be factory assembled prior to arriving at the job site

d. Isolating ring seals shall be RED Valve Series 40, Ronningen Petter Iso Ring, Moyno RKL Series W, Onyx Isolator Ring, or equal.

2. Tapped Isolating Ring Seals

a. Where indicated, pressure shall be sensed via a minimum 1-1/2" diameter spool type isolating ring seal mounted on a 1-1/2" pipe nipple at 90 degrees from the process piping.

b. An isolation ball valve shall be provided between the process piping and the ring seal, and a cleanout ball valve shall be provided between the ring seal and the atmosphere. The factory assembled and filled pressure instrument shall be back or side mounted to the ring seal such that the gauge or readout may be viewed normally.

c. Tapped isolating ring seals for solids service shall be Red Valve Series 42/742, Ronningen Petter Iso Spool, Onyx Isolator Ring, or equal.

## 2.05 FILLING MEDIUM:

A. The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10 degrees F to +150 degrees F.

B. Filling medium shall be silicone unless oxidizing agents, such as sodium hypochlorite, are present, then halocarbon shall be used.

## 2.06 TAMPER EVIDENT PAINT

A. Piping and screwed/bolted connections of instrumentation containing the filling medium shall be marked with a small continuous tick mark of tamper evident paint over each piping/instrument joint. Tamper evident paint shall be applied prior to instrument assemblies arriving on the job site. Disturbance of the joint shall break the paint.

B. Instrument assemblies with broken paint or missing paint shall not be accepted and shall be repaired or replaced at no additional cost to Owner. Paint shall be Dykem Cross-Check or equal.

## 2.07 ISOLATION VALVES

A. Isolation valves shall be 1/2 inch diameter ball valves, unless otherwise indicated, with a Type 316 stainless steel body, Type 316 stainless steel ball. Where 316 stainless steel is not compatible with the process fluid, materials of construction shall be suitable for the associated process fluid (e.g., PVC for chemical service).

## 2.08 ALARM ANNUNCIATION DEVICE

A. Sirens:

1. For Class I, Division 2 areas and non-hazardous areas:

a. Provide NEMA 4X and Class I, Division 2 rated alarm horn capable of 32 selectable warning tones. Coordinate tone selection with Owner. Volume shall be field adjustable between 0 and 114 dBA measured at 10 feet.

b. Alarm horn shall be the SelecTone 302GCX series with UTM tone module as manufactured by Federal Signal Corporation.

2. For Class I, Division 1 areas:

a. Provide NEMA 4X and Class I, Division 1 rated alarm horn capable of 32 selectable warning tones. Coordinate tone selection with Owner. Volume shall be field adjustable between 0 and 114 dBA measured at 10 feet.

b. Alarm horn shall be the SelecTone 302X series with UTM tone module as manufactured by Federal Signal Corporation.

B. Strobe Lights:

1. Strobes located within the same room, or otherwise visible from any shared frame of view, shall be synchronized per the requirements of NFPA 72. Strobes shall by synchronized by the strobe manufacturer's synchronization module. Strobe circuits shall not exceed the continuous duty current rating of the synchronization module. Synchronization module shall be Federal Signal Model SSM, Edwards Signaling Model EG1M-RM, or equal.

2. For Class I, Division 2 areas and non-hazardous areas:

a. Provide red strobe status indicator. Unit shall be rated NEMA 4X and Factory Mutual approved for a Class I, Division 2, Group D area. Unit shall contain a durable polycarbonate housing and be surface mount. Unit shall be UL listed. Strobe shall be powered from 24VDC.

b. Alarm strobe shall be Federal Signal Model 225XST, Edwards Signaling Model 116DEGEX-FJ, or equal.

3. For Class I, Division 1 areas:

a. Provide red explosion proof dome covered strobe unit rated NEMA 4X and Factory Mutual certified for a Class I, Division 1, Group D area. Unit shall be UL listed. Strobe shall be powered from 24VDC.

b. Alarm strobe shall be Federal Signal Model 27XST, Edwards Signaling Model 116DEGEX-FJ, or equal. Compatible mounting hardware by the strobe manufacturer shall be furnished.

4. Lens color shall be as indicated on the Drawings.

## PART 3 – EXECUTION

### 3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

**END OF SECTION**

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## SECTION 41 22 00
## CRANES AND HOISTS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install and make fully operational the crane and hoist systems in the locations and conditions of service, as shown on the Drawings and as specified in the Crane and Hoist Schedule.

1. Contractor shall be responsible for coordinating with the Metal Building Manufacturer under Section 13 24 19 – Metal Buildings and the monorail manufacturer to ensure the design of the metal building incorporates attachment of the monorail runway beams and loading from the beams and trolley hoists furnished under this Section.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

C. All equipment supplied under this Specification shall comply in all respects with the provisions of the Occupational Safety and Health Act of 1970, including all standards promulgated under the authority of such Act, and shall also meet all applicable industrial codes in the state of Georgia.

D. The manufacturer and ultimately the Contractor shall be totally responsible for structural design of the crane and hoist systems, for the compatibility of all equipment, and for verification of required operating clearances.

E. All parts of the mechanism furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation. All equipment specified herein shall be designed for the CMAA Duty Classification as specified herein.

F. If the Contractor elects to utilize the crane and hoist equipment in any way during the erection of piping and installation of equipment, they shall notify the Owner in writing and shall provide for an inspection by the equipment manufacturer and take any steps necessary to return the equipment to "as new" condition. They shall also obtain recertification by the manufacturer and reinstate all warranties and guarantees.

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## 1.02 CAPACITY AND DESIGN LOADS

A. All design loads shall meet CMAA requirements. The design load for stress calculations and deflection shall be based upon the requirements of CMAA and include Vertical Inertia Forces (VIF), Deal Load Factor (DLF), Hoist Load Factor (HLF), and Inertia Forces from Drives (IFD). Operating Wind Load shall be in accordance with Governing Building Code on areas exposed to wind.

B. The rated load capacity of each crane shall be clearly labeled on each crane using a label size easily read from the floor level and/or loading position.

## 1.03 CRANE AND HOIST SCHEDULE

| Location | Thermal Dryer Facility Building |
|---|---|
| **General** | |
| Quantity | 2 |
| Indoor/Outdoor | Indoor |
| Capacity (tons) | 3 |
| Operating Floor Elevation | 968.33 |
| **Crane** | |
| Crane Type | Monorail |
| Configuration | Straight |
| Span (feet) | 85.00 |
| **Trolley Hoist** | |
| Trolley Type | Motorized |
| Hoist Type | Electric Wire |
| ASME Duty Classification | Class H1 |
| **Hook Elevation** | |
| High Point | 988.00 |
| Low Point | 969.00 |
| Hook End Approach (inches) | 24 |
| **Operating Speeds** | |
| Maximum Trolley Speed (feet/minute) | 65 |
| Hoist Speed Range (feet/minute) | 20 (max) / 7 (min) |

All elevations and spans are approximate. All equipment shall be installed as shown on the Drawings.

## 1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes and standards refer to the most current issue available at the time of the Bid.

1. CMAA

2. AISC Manual of Steel Construction

3. ASTM A48 – Standard Specifications for Gray Iron Castings

4. ANSI B30.11 – Safety Code for Underhung Cranes and Monorail Systems

5. ANSI B30.16 – Safety Code for Overhead Hoists

6. AWS D14.0 – Machinery and Equipment Welding Specification

7. MMA MH27.1 – Monorail Manufacturers Association

8. OSHA 1910-179 – Occupation Safety and Health Administration

## 1.05 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the systems have been designed to resist all loads implied herein and loadings stipulated in the applicable building codes of the state of Georgia. The Certification shall also state that the design has been performed and signed and sealed by a Professional Engineer registered in the state of Georgia.

B. Certification that the equipment has been field tested and passed.

C. Details and design calculations shall be submitted, signed, and sealed by a Professional Engineer registered in the state of Georgia for any of the following components furnished by the Manufacturer:

1. Runway beams

2. Monorail patented track

3. Monorail suspension systems

4. End stops and connections

D. Complete layout drawings of entire monorail systems verifying entire access envelope of system, both vertically and horizontally at all levels of travel access including floor plans, equipment locations, access doors, etc. Hook extents, including maximum and minimum elevations and all clearances, shall be defined on drawings for proposed system.

## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. The equipment covered by this Section is intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment.

### 2.02 GENERAL

A. The crane system shall be constructed of structural steel, in accordance with current AISC and ASTM specifications. Minimum grade of structural steel shall be A36.

B. All crane components shall be new and come from reputable brands having domestic operations in existence for a minimum of 10 years.

C. All crane components will have properly finished ends and surfaces. Structural sections shall be saw cut producing clean ends dressed to eliminate sharp edges. Torch cuts with uneven edges will not be acceptable. Surfaces must be free of mill scale, rust, and debris properly prepared prior to coating.

D. Welding shall follow the current recommended practices of the AWS D14.0 specifications.

E. Moving members of the crane shall be separated by a clearance of at least 3 inches vertically from any overhead obstruction and 2 inches horizontally from any lateral obstruction.

### 2.03 MONORAILS

A. Unless otherwise indicated on the Drawings, monorail shall be patented track consisting of a top flange, web and hardened 3.25- or 3.33-inch bottom operation flange. Structural steel monorail tracks are acceptable for straight runs without switches or curves. All rails shall be furnished with splices and end stops and shall be designed for spans, thermal

expansion and contraction and turning radii as shown on the Drawings. Unless otherwise shown on the Drawings provisions shall be made for connection of monorail suspension system to support locations designated on Drawings. The suspension system shall provide support and bracing of all live, dead, and impact loads. Monorail shall be manufactured by Louden division of ACCO, TC/American Monorail, Cleveland Tramrail division of Gorbel, Tram Beam, or equal. Rated capacity of monorail shall be painted with stencil in black on both the hoist and the monorail beam.

## 2.04 TROLLEY HOISTS

A. Trolley hoists shall be as manufactured by ACCO Industries, Electrolift, or Yale.

B. All load carrying parts shall be of steel. Hoist fames shall be galvanized steel. Wheels shall be stainless steel with hardened treads. Wheels and axles shall be equipped with antifriction bearings which are permanently sealed and lubricated. The gear head of the motor shall have an alloy steel, heat-treated gear train operating in a fully enclosed oil bath. The gear shaft shall have precision, oil lubricated ball bearings. Where monorail track as specified or shown on the Drawings is curved, trolleys shall be the swivel-type to negotiate curved sections.

   1. Electrically operated trolleys shall include a gear-motor with solid-state soft start with adjustable time and torque, and electric brake.

   2. Manual trolleys shall be of hand-driven geared type.

C. The hoist drive shall be of the close-headroom, double reeved, cross-mounted type and shall include a geared train with inherent braking characteristics or mechanical load brake, hook, stainless steel wire rope, and stainless steel drum. Rated capacity shall be stamped on the hoist frame. The frame shall be oil-tight, of steel construction, with no part of the load carried by assembly bolts. Gearing shall be machine cut and heat-treated and shall operate in an oil bath. No gears shall be cantilever mounted. Shafting shall be ground and polished and all bearings shall be of the antifriction type. Grease fittings and oil reservoir shall be readily accessible. The drum shall be of the large diameter, guarded, flanged type with machine cut grooves to accommodate the hoist cable without overwrapping. Right- and left-hand drum grooving shall be utilized in close-headroom, double-reeved, cross-mounted hoist applications to provide a true vertical lift. The wire ropes shall be of the preformed extra flexible type, have a safety factor of at least five, and be anchored to the hoist drum. The load block shall be of the safety type with guarded sheaves and forged swiveled hooks. Hooks shall open slowly when subjected to heavy overloads.

   1. Electrically driven hoists shall include a two-speed, direct coupled motor, electrical controls, and solenoid brake. The solenoid brake shall be spring set with magnetic release operated by and interlocked with the electrical control equipment. Either a

worm gear drive with an inherent load brake or a mechanical load brake designed in accordance with the Hoist Manufacturer's Institute standards shall be provided for controlling the speed when lowering, and for holding maximum hook load for any load up to capacity. Stressed parts shall be of cast or forged steel. In the event of a power failure the braking system shall automatically lock the piece of equipment being lifted to prevent further movement. Hoists shall also include either a clutch-type or electric-type overload cut-off device to protect hoist from an overload condition.

2. Manual hoists shall include a handwheel and chain and a clutch-type overload cut-off device to protect hoist from an overload condition.

D. Rated capacity of trolley hoists shall be painted in black with stencil on the trolley hoist.

## 2.05 ELECTRICAL AND CONTROL REQUIREMENTS

A. Electrical power wiring and connection to the electrical system not integral to the equipment shall be provided under Division 26 – Electrical. All other power wiring associated with and integral to the hoist systems shall be furnished and installed under Division 41 – Material Processing and Handling Equipment.

B. All electrical appurtenances furnished by the equipment manufacturer shall be rated for installation in classified areas where such areas are indicated on the Drawings or specified herein.

C. All wiring between motor, limit switches and starters shall be short, compact and protected by rigid galvanized steel conduit or flexible steel neoprene jacketed cable. In corrosive areas, rigid galvanized steel conduit shall be PVC coated.

D. The electrical system providing power to the trolley drives and hoists shall be the insulated channel conductor type as specified herein.

1. Insulated Channel Conductor Type: An insulated channel conductor shall be supplied along the monorail where specified herein. The conductor shall be capable of carrying 100A per pole, 3-phase, 460V. The conductor shall be supported as recommended by the manufacturer. The conductor shall be "Saf-T-Bar" enclosed electrification as manufactured by Howell Corporation, Midland Ross, SAFPOWER as manufactured by Cleveland Tramrail, Duct-O-Bar, Magnetek, Conductix, or equal. The conductor channels shall be of stainless steel, flame retardant, amply double insulated. The system shall permit longitudinal movement of the housing and busways only to the extent to allow for expansion and contraction. An expansion joint section shall be provided as required for expansion and contraction and still maintain true alignment. Collectors shall be of the type required by the conductor manufacturer.

E. Starting equipment shall be integral with the crane drives and/or trolley hoist unit and shall be of the full voltage, magnetic-reversing type with three overload elements. Equipment shall be housed in an enclosure suitable to the conditions of service and as specified herein.

F. Hoisting motors shall be two-speed. The trolley motors shall be single speed, squirrel cage induction, NEMA Design "D". Motors shall be of the totally enclosed type designed for hoist service. The motor rating shall be on a 30-minute, 55-degree Celsius, duty cycle basis.

G. Electrical/Control Requirements

| | **Thermal Dryer Facility Building** |
|---|---|
| Area Classification | Class II, Division 2, Group D |
| NEMA Rating of Components | NEMA 4X |
| Electrical System | Insulated Channel Conductor |
| Control System | Pendent |
| **Motors** | |
| Rating | 460V, 3 ph, 60 Hz |
| Trolley Motor Horsepower (hp) | 0.6 |
| Hoist Motor Horsepower (hp) | 7.8 |
| Enclosure | TEFC-XP |
| Insulation | Class F |
| Inverter Duty | No |
| Service Factor | 1.15 |
| Space Heater | No |
| Motor Winding Temperature Switches | No |

H. Limit switches shall be approved geared typed, positive in action, compact, oil proof and readily accessible. Solenoid brakes shall be disk type, spring set with magnetic release. Solenoids shall be totally enclosed, protected from oil and moisture, readily accessible for adjustment and maintenance and shall develop the required forces without overheating.

I. All electrical and control components shall conform to the applicable standards of UL and NEMA, unless specified otherwise. IEC standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

## 2.06 CONTROLS

A. The Control System providing control of the trolley drives and hoists shall be through wired pendent controls as specified herein.

1. Pendent controls for lift and travel shall be provided complete with heavy-duty push-button station of constant pressure type with silver-to-silver contact elements, and sufficient control cable and chain for support of the control station at a point 4 feet above the lowest operating floor where multiple levels are to be accessed. A balancer shall be provided which will allow the control pushbutton station to be retracted to a maximum of 4 feet above the upper operating level. Two speed control of the hoist drive shall be affected by a two-step pushbutton. Pendant controls shall be suspended from the hoist for monorail applications.

B. Control power shall be 120V provided by a control power transformer within the starter units. One side of this transformer shall be grounded, the other side shall be connected via a fuse of adequate rating.

# PART 3 – EXECUTION

## 3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for each crane and hoist system:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 1 |
| Startup | 1 | 1 |

## 3.02 INSTALLATION

A. All crane equipment shall be installed in accordance with the applicable sections of Division 05 – Metals, Division 26 – Electrical, and the manufacturer's instructions and recommendations.

## 3.03 FIELD TESTS

A. Field tests shall be conducted in accordance with Section 46 00 00 – Equipment General Provisions and the manufacturer's instructions and recommendations. Prior to initial use, all cranes shall be proof-tested at 125% of their rated load in accordance with all OSHA requirements.

## 3.04 PAINTING

A. The crane shall be painted ANSI safety yellow before shipment. Painting shall be in accordance with Specification Section 09 90 00 – Painting.

B. A wire-brushing and/or solvent wipe shall be performed prior to painting to clean and remove debris, mill scale, dirt, and oils.

C. At least one quart of matching color paint shall be shipped with each crane for field touch-ups.

D. The crane shall be properly banded and skidded prior to shipment. Any paint damage, scratches, blemishes to the finish of the crane, caused by shipping, transportation via common carrier, etc., shall be repaired by the Contractor.

E. Rated capacity of crane system shall be painted with stencil in black on all components of crane system as specified herein.

**END OF SECTION**

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**SECTION 43 20 00**

**PUMPS – GENERAL**

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Comply with the requirements of Section 46 00 00 – Equipment General Provisions.

B. Pumps shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. The provisions of this Section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.

D. All pumps provided under an individual Specification Section shall be by the same manufacturer unless otherwise indicated in the Section.

E. All equipment for the pumps, including but not limited to motors, cans and bases, shall be provided as a complete unit by the pump Manufacturer.

F. The pump Manufacturer shall have unit responsibility for coordinating the proper pump mounting system with the Contractor to ensure stable pump operation free from abnormal vibration.

G. The pump Manufacturer shall include, in their bid, time, labor, and special tools required for installation assistance, testing and startup with the Contractor.

### 1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All equipment, materials and installations shall conform to the requirements of the specifications, codes and standards listed in Section 01 42 00 – References. In addition, equipment, installation and testing shall be in accordance with the following applicable codes, standards and guidelines. All codes, standards and guidelines shall be the most recent editions with latest revisions, supplements and amendments of the specifications, codes and standards.

1. ANSI/HI

    a. ANSI/HI 3.1-3.5 – Rotary Pumps for Nomenclature, Definitions, Application and Operation

    b. ANSI/HI 3.6 – Rotary Pump Test

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c. ANSI/HI 9.6.1 – Rotodynamic Pumps – Guideline for NPSH Margin

d. ANSI/HI 9.6.2 – Rotodynamic Pumps for Assessment of Applied Nozzle Loads

e. ANSI/HI 9.6.3 – Rotodynamic Pumps – Guideline for Operating Regions

f. ANSI/HI 9.6.4 – Rotodynamic Pumps for Vibration Measurements and Allowable Values

g. ANSI/HI 9.6.5 – Rotodynamic Pumps Guideline for Condition Monitoring

h. ANSI/HI 9.6.6 – Rotodynamic Pumps for Pump Piping

i. ANSI/HI 9.6.8 – Rotodynamic Pumps - Guideline for Dynamics of Pumping Machinery

j. ANSI/HI 9.8 – Rotodynamic Pumps for Pump Intake Design

k. ANSI/HI 11.6 – Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Tests

l. ANSI/HI 12.1-12.6 – Rotodynamic Slurry Pump for Nomenclature, Definitions, Applications and Operation

m. ANSI/HI 14.1-14.2 – Rotodynamic Pumps for Nomenclature and Definitions

n. ANSI/HI 14.3 – Rotodynamic Pumps for Design and Application

o. ANSI/HI 14.6 – Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

2. ANSI/ASME B73.1 – Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process

3. ANSI/AWWA E103 – Standard for Horizontal and Vertical Line-Shaft Pumps

4. ASTM

a. ASTM A36 – Specification for Structural Steel

b. ASTM A48 – Specification for Gray Iron Castings

c. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

d. ASTM A148 – Specification for Steel Castings, High Strength, for Structural Purposes

e. ASTM A193 – Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service

f. ASTM A276 – Specification for Stainless Steel Hot/Cold-Finished Bars

g. ASTM A322 – Specification for Steel Bars, Alloy, Standard Grades

h. ASTM A514 – Specification for High Yield Strength, Quenched and Tempered alloy Steel Plate, Suitable for Welding

i. ASTM A532 – Specification for Abrasion-Resistant Cast Irons

j. ASTM A536 – Specification for Ductile Iron Castings

k. ASTM A565 – Specification for Martensitic Stainless Steel Bars

l. ASTM A582 – Specification for Free-Machining Stainless and Heat-Resisting Steel Bar, Hot-Rolled and Cold-Rolled

m. ASTM A743 – Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel and Nickel-Base, Corrosion-Resistant for General Application

n. ASTM B148 – Specification for Aluminum-Bronze Sand Castings

o. ASTM B584 – Specification for Copper Alloy Sand Castings for General Application

p. ASTM E10 – Standard Test Method for Brinell Hardness of Metallic Materials

5. ANSI

a. ANSI B16.1 – Standard for Cast Iron Pipe Flanges and Flanged Fittings

b. ANSI B16.5 – Standard for Pipe Flanges and Flanged Fittings

6. ANSI/NFPA 70 – National Electrical Code

7. SAE J404 – Chemical Compositions of SAE Alloy Steels

8. ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state

9. Comply with the requirements of Section 46 00 00 – Equipment General Provisions.

B. Related Work Specified Elsewhere

1. Section 03 60 00 – Grout

2. Division 5 – Metals

3. Section 09 90 00 – Painting

4. Division 26 – Electrical

5. Division 40 – Process Interconnections

6. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equpment

7. Division 46 – Water and Wastewater Equipment

## 1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data

1. Comply with Section 01 33 00 – Submittals.

2. Fabrication information.

B. Provide submittals identified in Specification Section 46 00 00 – Equipment General Provisions in addition to the submittals identified herein and in addition to the submittals identified in the individual pumping Specification Sections.

C. Shop Drawings shall include the following information in addition to the requirements of Section 01 33 00 – Submittal Procedures and shall include the following information in addition to the requirements of Section 01 33 00 – Submittal Procedures:

1. Pump name, identification number and specification number.

2. Performance characteristics and descriptive data, including but not limited to:

a. Pump performance curves at rated speed and reduced speeds (if reduced speeds are specified)

b. Pump performance data shall be provided for the:

1) Proposed impeller diameter

2) Maximum impeller diameter possible with the proposed pump

3) Minimum impeller diameter possible with the proposed pump

c. Curves shall indicate:

1) Information specified elsewhere

2) Impeller diameter

3) Minimum continuous stable flow (minimum flow to avoid suction recirculation)

4) Preferred operating region (POR) per ANSI/HI 9.6.3

5) Allowable operating region (AOR) per the latest version of ANSI/HI 9.6.3.

6) Performance curves submitted shall be for the entire pump assembly, including efficiency corrections and losses.

7) Pump performance curves shall be submitted both in the form of performance data cut sheets and in tabular format. Tabular data shall include the following:

   a) Flow

   b) Pump head (pressure for positive displacement type pumps)

   c) NPSH required (net positive inlet pressure, NPIP, for positive displacement type pumps)

   d) Pump efficiency

   e) Rated driver horsepower

   f) Brake horsepower

   g) A minimum of 10 data points shall define rotodynamic pump performance curves listed above. Performance curve data points shall include the following:

      i. best efficiency point

      ii. all specified operating points

      iii. preferred operating region minimum and maximum

      iv. allowable operating region minimum and maximum

      v. shutoff condition

      vi. runout

      vii. The remainder of the points shall be distributed evenly to clearly define the shape of each of the curves.

viii. Each data point shall be reported to a minimum of 3 significant figures.

ix. The curve data shall align with the HI acceptance grade (1B, 2B, 1U, etc.) as specified in the individual pump specification and shall explicitly state the applicable tolerance band, as defined by the Hydraulic Institute Standards, associated with each value.

3. Minimum submergence requirements shall be provided for vertically suspended pumps and submersible pumps.

4. Detailed dimensional drawings, data and setting plans including but not limited to:

   a. General cutaway sections

   b. Materials

   c. Dimension of shaft projections

   d. Shaft and keyway dimensions

   e. Shaft diameter (dimensioned at the coupling)

   f. Shaft-impeller connection details

   g. Dimension between bearings

   h. General dimensions of pump

   i. Suction head bolt orientation

   j. Anchor bolt locations

   k. Forces: Itemized forces shall be determined at specified operating points and at pump shutoff condition.

   l. Assembly views

   m. Exploded parts view with associated bill of materials

   n. Cutaway images

   o. Provide weight of entire pump assembly, including motor and base weight of individual major subassemblies. Indicate the weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure. Itemized loads shall be determined at specified operating points and at pump shutoff condition.

p. Impeller (illustration and statement of the number of vanes)

q. Drawings shall identify each component by tag number to which the catalog data and detail sheets pertain.

r. Mass of rotating assembly

s. Mass of coupling(s)

t. Seals

5. Drive and motor data as required by Division 26 – Electrical. Complete motor data shall include but not be limited to:

a. Size

b. Make

c. Mass of motor

d. Inertia of driver

e. Motor enclosure type

f. Characteristics

g. Wiring diagrams

h. Variable speed drive (VSD) information and data: Where pump and motor speeds are to be regulated by VSDs, the Contractor shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit pump, motor and VSD shop drawings together as a complete system.

i. Comply with submittal requirements for motors in Division 26 – Electrical.

6. Information on pump and motor bearings, including but not limited to:

a. Bearing types

b. Rated bearing life

c. Bearing life calculations for the specified operating points.

d. Bearing arrangement

7. Gear box design and performance criteria and AGMA service factor.

8. Equipment protective device details and connection diagrams.

9. Details of shaft sealing system including seal/packing type, seal water control devices, and seal water piping schematic.

10. Information on pump appurtenances including but not limited to:

    a. Couplings

    b. Shaft guards

    c. V-belt drive systems

11. Submersible pump submittals shall also include:

    a. Product data sheets for power and control cables, length of cables and cable support system.

    b. Details on pump guide rail system and mounting requirements.

    c. Details on submersible pump's retrieval system.

12. Any additional information required to demonstrate compliance with the specifications.

D. Under separate submittal, provide results of structural, lateral, and tortional dynamic analyses as required herein and in the individual Specification Sections.

E. Manufacturer's literature and brochures

F. Lubrication Information: Complete lubrication instructions and lubricant schedule, including Manufacturer's recommended lubricant. All lubricants shall be food grade, NSF 61 approved, or equivalent. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application. Comply with Section 46 00 00 – Equipment General Provisions.

G. Materials of construction data and associated specifications (such as AISI, ASTM, SAE, etc.), including but not limited to:

1. Grade

2. Type

3. Mechanical properties, including but not limited to:

    a. Brinell hardness number

    b. Galling resistance

4. In any instance of material substitutions, also provide elemental makeup by percent elemental constituent.

H. Coatings: Coating system data and description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

I. Seals (Packing and/or Mechanical Seals)

1. Cut sheets

2. Technical data

3. Materials of construction

4. Pressure ratings

5. Flush requirements (flow and pressure)

6. Detailed dimensional drawings

7. Exploded parts view with bill of materials

## 1.04 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittals

2. Section 01 61 00 – Product Requirements and Options

3. Section 01 75 00 – Checkout and Startup Procedures

B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 – Operation and Maintenance Data.

## 1.05 MAINTENANCE MATERIALS SUBMITTALS

A. O&M manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittal Procedures.

2. Section 01 78 23 – Operation and Maintenance Data.

B. Comply with Section 01 78 43 – Spare Parts and Extra Materials.

C. Comply with Section 01 79 00 – Instructions to Owner’s Personnel.

D. Comply with Section 46 00 00 – Equipment General Provisions.

## 1.06 QUALITY ASSURANCE SUBMITTALS

A. Factory Testing Plan: Wherever factory tests are specified, testing plan shall include but not be limited to the following:

1. Testing procedures

2. Testing equipment

3. Test arrangement

4. Test conditions

5. Speed of rotation of test

6. Test facility systems and equipment, including but not limited to:

a. Test facility electrical power characteristics certification letter statement including volts, phase, frequency, current, transformer and VSD features

b. Calibrated factory motor (where applicable) with calibrated efficiency curves

c. Calibrated factory drive (where applicable) with calibrated efficiency curves

B. Factory test results shall be submitted and approved prior to shipment of equipment.

C. Shipment, delivery, handling and storage instructions

D. Installation instructions

E. Field testing plan

F. Comply with Section 01 75 00 – Checkout and Startup Procedures

G. Preliminary field test data

H. System field quality control testing

I. Final field test data

J. Certified test reports

K. Startup report including data substantiation of successful completion of 30-day operational demonstration performance data.

L. Letter certification that critical speeds are outside operating speed and vane pass frequency ranges

## 1.07 GENERAL INFORMATION AND DESCRIPTION

A. Comply with Section 46 00 00 – Equipment General Provisions.

## 1.08 DYNAMIC ANALYSIS

A. If no specific dynamic analysis requirements are included in the individual pump Specification Section, the shop drawing submittal shall include a certification that no critical speeds fall within 25% of (above or below) the pump operating speed frequency and/or within 25% of (above or below) the vane pass frequency ranges (i.e., vane pass frequency ranges for volute style pumps).

## 1.09 WARRANTY

A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options. Warranty requirements are supplementary to the individual equipment specifications.

B. Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

## 1.10 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS:

A. When operating at the maximum output speed each pump shall have a characteristic performance curve which meets the conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full range of speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency as defined herein shall include all mechanical losses from bearings and shaft seals.

B. The impeller diameter required for the specified operating conditions shall not exceed 95% of the maximum impeller diameter of the pump provided to allow increased duty for future conditions.

C. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to backflow, including but not limited to back spinning from a dead stop and/or via a flow reversal condition that occurs immediately subsequent to a forward flow condition, through the pump with the maximum TDH specified available at the pump discharge flange.

D. Pump Manufacturer shall certify a Minimum Continuous Stable Flow (MCSF) rating at maximum speed that is lower than the specified minimum operating flow. Where a reduced speed operating condition is specified, the pump Manufacturer shall also certify MCSF at the pump speed required to meet this condition.

E. Factory test acceptance grade for rating point shall be as specified herein, except where superseded via individual Specification Section and/or scheduled values in the individual

pump Specification Sections; however, power required shall not exceed the rated motor horsepower.

F. Pump Operating Conditions: Refer to respective individual pump Specification Sections for specific performance requirements.

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Performance Curves: All centrifugal pumps shall have a continuously rising curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or drive. Safety factors will not be considered in determining compliance with this requirement.

B. Suction and discharge flanges shall conform to ASME B16.1 or B16.5 dimensions.

C. The minimum ABMA L10 bearing life for all pump, motor and drive bearings shall be 60,000 hours unless otherwise specified in the individual pump Specification Sections.

### 2.02 ANCHORS AND SUPPORTS

A. Comply with the following Specification Sections:

1. Specification Section 05 05 23 – Metal Fastening.

2. Specification Section 46 00 00 – Equipment General Provisions.

3. Comply with individual pump Specification Sections.

C. Section 01 73 23 – Anchorage and Bracing of Non-Structural Components.

### 2.03 DEFAULT MATERIALS

A. Pumps shall be constructed out of the materials specified in respective individual pumping Specification Sections. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:

| Component | Materials of Construction |
|---|---|
| Casings and Bowls | Close-grained gray cast iron, conforming to ASTM A48, or equal |
| Impellers | Water: ASTM B148, aluminum bronze or Type 316 stainless steel<br>Wastewater: ASTM A536, Hard Iron |

| Component | Materials of Construction |
|---|---|
| Shafts, Wetted | 400 series stainless steel |
| Shafts, Non-Wetted | AISI 4140 steel |
| Miscellaneous Stainless Steel Parts | Type 316 stainless steel |
| Anchor Bolts and Fasteners | Type 316 stainless steel |

## 2.04 COMPONENTS

A. Refer to individual Specification Sections for specific requirements.

B. Pump Shaft

1. The shaft shall be heat treated, turned, ground, and polished over its entire length and shall be provided with keyways on both ends.

2. The shaft shall be sufficiently large in diameter to safely transmit the maximum torque developed by the drive unit and provide a rigid support for the impeller to prevent excessive vibration.

C. Bearings

1. Bearings shall be designed for continuous heavy duty loads and for both axial and radial thrust loads.

2. Except as otherwise specified, the specified ABMA L10 life for bearings shall be under worst possible operating conditions.

3. Bearings shall support the shaft and the complete rotating elements.

D. Wear Rings

1. Wear rings shall meet or exceed the requirements of API 610, including but not limited to the following features:

a. Brinell hardness and Brinell hardness difference between adjacent wear parts.

b. Wear ring clearances

2. Adjacent wear ring material combinations shall be non-galling.

E. Seals

1. Mechanical seals shall be furnished as specified in individual pumping equipment Specification Sections.

2. If the pump Manufacturer recommends a “better” seal or alternate flushing arrangement for a specific application, it may be submitted to the Engineer for approval in accordance with the requirements of Section 01 25 00 – Substitution Procedures.

## 2.05 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment supports, etc. shall conform to the requirements of Section 05 12 00 – Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM standards.

## 2.06 DISSIMILAR METALS

A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

## 2.07 GALVANIZING

A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

## 2.08 STANDARDIZATION OF GREASE FITTINGS

A. Grease Fittings: Comply with Section 46 00 00 – Equipment General Provisions.

## 2.09 APPURTENANCES

A. Pressure Gauges

1. Contractor shall supply all pressure gauges for all pumps by one manufacturer.

2. Gauges shall be provided through the instrumentation and control system subcontractor to match other gauges on the project.

3. Gauges shall be as specified in Section 40 73 13 – Pressure and Differential Pressure Gauges.

4. All gauges shall be provided with diaphragm seals or isolating ring seals as specified in Section 40 79 00 – Miscellaneous Instruments, Valves and Fittings.

5. The Contractor shall furnish and install pressure gauges as shown on the Drawings, but the following gauges shall be provided as a minimum:

a. On the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps.

b. On the discharge piping of each wet-pit submersible pump and vertical turbine pump in the locations shown on the Drawings or as directed by the Engineer.

6. Gauge ranges shall be coordinated with the pump Manufacturer and shall meet the following requirements, except where otherwise specified:

| Location | Type | Graduation | Suction Range | Discharge Range |
|---|---|---|---|---|
| Suction | Single Scale, Compound | Feet H20 | -34 feet | +34 feet |
| Discharge | Single Scale | Feet H20 | 0 feet | Greatest of the following:<br>Shutoff + 5 feet OR<br>130% of Maximum |

B. Shaft Couplings:

1. Except as otherwise specified in individual pump Specification Sections, flexible couplings for direct driven pumps shall be provided between the pump shaft and driver and keyed to pump and driver shafts. Flexible couplings shall be internal metal grid type couplings with a metal flange on both shafts with a metal cage in between, as manufactured by Falk, or equal.

2. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.

3. Comply with Section 46 00 00 – Equipment General Provisions with respect to protective guard requirements.

C. Equipment Guards: Provide guards in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.

D. Provide access to:

1. Couplings

2. Oil drains

## 2.10 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 26 – Electrical Specification Sections and the latest National Electric Code.

B. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation. The use of service factor will not be allowed in determining overloaded condition.

C. In the individual pump specifications, specified motor horsepower is intended to be the maximum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

D. Where variable frequency drives (VFDs) and/or VSDs are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD/VSD supplier to ensure a complete and operational system. VFDs/VSDs shall be furnished under Division 26 – Electrical unless otherwise specified in the pump specification.

E. Motor starters and controls shall be furnished and installed under Division 26 - Electrical and Division 40 – Process Interconnections unless otherwise specified in the individual pump specifications.

## 2.11 SPARE PARTS AND SPECIAL TOOLS

A. Accessories, spare parts, and special tools shall be provided in accordance with Section 01 78 43 – Spare Parts and Extra Materials.

B. Spare parts for equipment shall be furnished where indicated in the equipment Specifications and/or where recommended by the equipment manufacturer.

C. Spare parts shall be identical and interchangeable with original parts.

D. The Contractor shall furnish a 1-year supply of all recommended lubricating oils and greases.

E. Comply with Section 01 78 43 – Spare Parts and Extra Material.

## 2.12 EQUIPMENT IDENTIFICATION

A. Comply with the requirements of Section 46 00 00 – Equipment General Provisions.

B. All pumps shall be provided with a stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with:

1. The Manufacturer's name

2. Year of manufacture

3. Model number

4. Serial number

5. Principal rating data including the following at the rated design point:

    a. Capacity in gallons per minute

b. Rated total dynamic head

c. Speed in rotations per minute

d. Efficiency

C. Each pump shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump – 1 (RWP-1)". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

D. Nameplates shall not be painted over.

## PART 3 – EXECUTION

### 3.01 SHOP TESTING

A. The terms Shop Testing and Factory Testing shall be considered to be interchangeable.

B. Perform Shop Testing in conformance with Section 46 00 00 – Equipment General Provisions.

C. The Contractor shall be responsible for the coordination of factory testing of each pump, VSD, and motor. Unless required as indicated by the individual pump Specification Sections, Manufacturer-provided factory test motors and factory variable speed controllers (as necessary) shall be used for factory performance testing.

D. Except as otherwise specified, factory testing shall be conducted in accordance with the latest version of

1. ANSI/HI 14.6.

2. For submersible pumps, testing shall be conducted in accordance with the latest version of ANSI/HI 14.6 and ANSI/HI 11.6.

3. For rotary pumps, testing shall be conducted in accordance with the latest version of ANSI/HI 3.6.

4. Pumps shall be tested within plus or minus 3 percent of the pump design speed. Affinity laws shall be used to adjust performance within this range to the design condition hydraulics.

E. Hydraulic Performance Acceptance Tests

1. The testing procedure shall be submitted to the Engineer for review and approval before scheduling the testing. The Owner/Engineer shall be given at least 2 weeks' advanced notice of the scheduled testing date.

2. Notification and payment of expenses for witness testing shall be as described in Section 46 00 00 – Equipment General Provisions wherever individual pump Specification Sections call for witness testing.

3. Specified hydraulic operating condition tolerances for rotodynamic pumps shall be as follows unless otherwise specified in the individual pump Specification Sections:

    a. The design or rated pump operating point shall be within the tolerances specified for Acceptance Grade 1U as defined by ANSI/HI 14.6.

    b. Additional Design Points

        1) The specified low flow pump design point shall have a unilateral positive head tolerance; no negative head tolerance is allowed at the defined flow condition.

        2) The specified high flow pump design point shall have a unilateral positive flow tolerance; no negative flow tolerance is allowed at the defined head condition.

4. Factory performance test shall include a minimum of seven test points between shutoff and runout.

5. Where required by the individual equipment Specification Sections, NPSH (NPIP for rotary pumps) tests shall be conducted to demonstrate compliance with the specified NPSH (NPIP for rotary pumps) requirements.

6. Net Positive Suction Head Testing for rotodynamic pumps shall be as follows unless otherwise specified in the individual pump specifications:

    a. An NPSH test for a single operating condition shall be executed. The test flow shall be greater than the specified high flow operating condition and shall be identified by increasing the flow until a 3% drop in head occurs relative to the expected head if sufficient NPSH were available.

    b. If during the NPSH test the pump's maximum flow condition is reached prior to identification of the NPSH3 value (i.e., control valve is fully open or the pump is operating at the edge of the AOR), the NPSHa at that operating condition shall be documented as the maximum NPSH3 value.

7. Factory test results shall include NPSHr curve.

8. Certified test curves shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications.

    a. Certified tests will not be required for submersible sump pumps with motors less than 5 hp.

b. Certified curves shall identify minimum continuous stable flow, POR, and AOR per the latest version of ANSI/HI 9.6.3.

c. Certified performance curves shall include the NPSH3 value identified during testing. An NPSH3 curve shall be calculated over the pump's AOR based on the documented test value(s). A clear designation shall be provided on the certified performance curve indicating calculated portions of the NPSH curve.

9. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.

10. All instruments shall be calibrated as required by ANSI/HI 14.6, 11.6, or 3.6 as applicable.

F. Where required in the individual pump Specification Sections, a certified hydrostatic test shall be completed on each pumping unit in accordance with ANSI/HI 14.6 or 11.6 as applicable. Hydrostatic test pressure shall be 1.5 times maximum operating head or 1.25 times shutoff head, whichever is greater.

G. Where required in the individual pump Specification Sections, each individual casting shall be Brinell tested in a minimum of two places, in an area of representative casting thickness to ASTM E10. Results shall be certified by a registered Professional Engineer.

H. Shop testing of electric motors shall conform to:

1. Section 46 00 00 – Equipment General Provisions

2. Section 26 05 60 – Low-Voltage Electric Motors

3. Section 26 05 00 – Basic Electrical Requirements

## 3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

B. Storage of equipment shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

D. Machined surfaces of all exposed pump openings or other exposed unpainted surfaces shall be protected by wooden blanks or Cosmoline, as appropriate, strongly built and securely bolted thereto.

E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

## 3.03 MANUFACTURER'S FIELD SERVICES

A. Manufacturer’s field services shall be in accordance with:

1. Section 01 75 00 – Checkout and Startup Procedures

2. Section 01 79 00 – Instruction of Owner Personnel

3. Section 46 00 00 – Equipment General Provisions

B. Unless otherwise referenced in the individual pump Specification Sections, as a minimum the services of the Manufacturer's representative shall be provided for as stated in the following schedule:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 2 |
| Startup | 1 | 2 |

C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

## 3.04 INSTALLATION

A. Pumping equipment shall be installed in accordance with Section 46 00 00 – Equipment General Provisions, the Manufacturer's recommendations, accepted procedures submitted with the shop drawings and as indicated on the Drawings, unless otherwise accepted by the Engineer.

B. Level pump and motor and grout feet or baseplate with grout in accordance with Section 03 60 00 – Grout and in accordance with Section 46 00 00 – Equipment General Provisions. Ensure minimum grout depth is obtained as recommended by the pump and grout manufacturers.

C. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with stainless steel pipe or copper tube (as appropriate for the environment), properly supported with brackets.

D. Contractor shall have unit responsibility for the proper coordination, sizing, and installation of the pump foundation/mounting requirements based on the Manufacturer’s recommendations, subject to Engineer’s review and comment.

## 3.05 ALIGNMENT

A. Pumping equipment shall be aligned in accordance with Section 46 00 00 – Equipment General Provisions, the Manufacturer's recommendations, accepted procedures submitted with the shop drawings and as indicated on the Drawings.

B. Equipment shall be aligned and free from binding, scraping, excessive vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.

C. As a minimum, comply with International Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

## 3.06 FIELD TESTING

A. Comply with Section 46 00 00 – Equipment General Provisions for applicable preliminary and final field testing requirements supplementary to those described in this specification.

B. Comply with Section 01 75 00 – Checkout and Startup Procedures.

C. All pumping units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation over the full operating speed range, without excessive noise, vibration, cavitation, and overheating of the bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Pumps shall be tested for vibration over the full specified speed range. Unless otherwise required by individual Specification Sections, vibration shall be within the limits identified in the latest version of ANSI/HI 9.6.4 or Manufacturer's limits if more stringent. If vibration is greater than 80% of the limits identified in ANSI/HI 9.6.4, follow-up vibration testing shall be completed after a 90-day break-in period to ensure that vibration remains within ANSI/HI 9.6.4 allowable limits. If vibration exceeds the allowable limits during the follow up testing, modifications shall be made as a warranty repair.

2. Bearing temperatures shall be determined. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.

3. In addition to dynamic analysis requirements specified and defined in HI 9.6.8, where Level 2 or Level 3 analysis is specified or otherwise specified in the individual pump specifications, the natural frequencies of each installed pump shall be determined using the “bump test” method. Field natural frequency testing shall

demonstrate a minimum of 10% field separation from the 1x running speed, 2x running speed and vane pass frequencies. If less than 10% field separation is demonstrated, then field test information shall be incorporated into the models developed for this facility for confirmation and evaluation purposes. In addition, pump train coast down testing shall be performed for comparison purposes to bump testing results.

4. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, motor power, flow, pump suction head, and pump discharge head, for at least five pumping conditions at full speed. One of the points shall be within -5% and 0%, and one being within 0% and +5% of the rated condition point flow rate; the remaining three points shall be spaced over the allowable operating region of the pump performance curve with points taken at or near the maximum allowable (shutoff) head region and at or near the maximum allowable flow (runout). Additional reduced speed testing shall be performed to demonstrate that pumps can achieve performance at turndown conditions where specified in individual pump Specification Sections. Each power lead to the motor shall be checked for proper current balance. Flow shall be measured to the extent possible by permanently installed instrumentation or drawdown measurement. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing. Field performance testing shall meet HI 14.6 pump acceptance test grade tolerance band grade 3B for all required test points.

D. The field testing shall be witnessed by the Owner or its representative. The Contractor shall submit to the Engineer a written notification of all pump field tests a minimum of 1 week prior to testing. In the event of failure of any pump to meet any of the above requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional compensation, until found satisfactory. The Contractor shall then certify in writing that the equipment has been satisfactorily tested, and that all final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The costs of all work performed in this Paragraph by factory-trained representatives shall be borne by the Contractor.

## 3.07 FAILURE OF EQUIPMENT TO PERFORM

A. Comply with Section 46 00 00 – Equipment General Provisions.

## 3.08 PAINTING

A. Comply with Section 46 00 00 – Equipment General Provisions.

B. Comply with Section 09 90 00 – Painting.

**END OF SECTION**

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## SECTION 43 25 13.10

## WET PIT SUBMERSIBLE SOLIDS-HANDLING PUMPS

### PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place into satisfactory operation submersible solids-handling pumps, associated variable frequency drives (VFDs), and a packaged control panel at the locations shown on the Drawings and as specified herein. All pumps specified herein shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 43 20 00 – Pumps – General.

C. Furnish VFDs for the pumps in accordance with Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers. The pump manufacturer/supplier shall be responsible for providing a complete working system.

D. The pump and all related equipment shall be designed for the wastewater applications specified herein and shall be suitable for continuous operation. The pump shall be bottom/end suction, side discharge construction and shall be supplied with a foot mounted discharge connection elbow and integral sliding rail removal system of the pump manufacturer's design matched to the pumps being supplied.

E. Orientation of Installation: Vertical

### 1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with Section 43 20 00 – Pumps – General

### 1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data: Comply with Section 01 33 00 – Submittal Procedures.

B. Provide submittals identified in Section 46 00 00 – Equipment General Provisions in addition to the submittals identified herein and in addition to the submittals identified in other referenced specification sections.

C. Provide submittals identified in Section 43 20 00 – Pumps – General.

D. Pump elbow base

E. VFD

5-23-2024

## 1.04 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 61 00 – Product Requirements and Options

B. Comply with Section 43 20 00 – Pumps – General.

## 1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 78 23 – Operation and Maintenance Data

B. Comply with Section 01 78 43 – Spare Parts and Extra Materials.

C. Comply with Section 01 79 00 – Instructions to Owner's Personnel.

D. Comply with Section 43 20 00 – Pumps General.

E. Comply with Section 46 00 00 – Equipment General Provisions.

## 1.06 QUALITY ASSURANCE SUBMITTALS

A. Comply with Section 43 20 00 – Pumps – General.

B. Comply with Section 01 75 00 – Checkout and Startup Procedures.

## 1.07 GENERAL INFORMATION AND DESCRIPTION

A. Comply with Section 46 00 00 – Equipment General Provisions.

## 1.08 DYNAMIC ANALYSIS (NOT USED)

## 1.09 WARRANTY

A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options. Warranty requirements are supplementary to the individual equipment specifications.

B. Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

## 1.10 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

**Submersible Pump Performance Criteria Schedule – 43 25 13 - 02**

| | Final Effluent Water Pumps |
|---|---|
| Number of Units | 2 |
| Pump Identification Numbers | P27111, P27112 |
| Pump Shutoff Head (Allowable Range) (feet) | 215 to 270 |
| Rating Point (at Full Speed) | |
| Flow (gpm) | 475 |
| Total Head (feet) | 202 |
| Minimum Pump Efficiency (%) | 48 |
| NPSH Required shall not exceed (feet) | 20 |
| Operating Point shall be within | Allowable Operating Range |
| Maximum Rated Horsepower (hp) | 75 |
| Maximum Pump Rated Speed (rpm) | 3,600 |
| Fluid Pumped | Final Effluent Water |
| Fluid Temperature (degrees Fahrenheit) | Ambient |
| Fluid Specific Gravity | 1.0 |
| Fluid pH range | 6 to 8 |
| Fluid Viscosity (absolute centipoise at 60 degrees Fahrenheit) | 1.1 |
| Minimum Suction Diameter (inches) | 3 |
| Minimum Discharge Diameter (inches) | 3 |
| Discharge Configuration | Center |
| Drive Configuration | Close Coupled |
| Direction of Rotation when Viewed from Driver End (top) | Clockwise |
| Minimum ABMA L10 Bearing life within POR (hours) | 50,000 |
| Factory Test Acceptance Grade | 2B |
| Rated Starts Per Hour, Minimum | 10 |
| Area Classification | Unclassified |

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Comply with Section 43 20 00 – Pumps – General, except where superseded in this specification section.

B. Pump Type: Non-clog, wet pit submersible, centrifugal pump.

### 2.02 ACCEPTABLE MANUFACTURERS

A. Pump Manufacturer

1. Xylem/Flygt

2. Or Equal

B. All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump manufacturer.

### 2.03 ANCHORS AND SUPPORTS

A. Comply with the following Specification Sections:

1. Section 05 05 23 – Metal Fastening

2. Section 46 00 00 – Equipment General Provisions

3. Comply with individual pump Specification Sections.

B. Comply with Section 43 20 00 – Pumps – General.

### 2.04 MATERIALS OF CONSTRUCTION

**Materials of Construction Schedule – 43 25 13 - 03**

| Component | Materials of Construction |
|---|---|
| **Final Effluent Water Pumps** | |
| Casing | Cast Iron, ASTM A48, CL30 to 40 |
| Suction Cover | Cast Iron, ASTM A48, CL30 to 40 |
| Seal Chamber | Cast Iron, ASTM A48, CL30 to 40 |
| Bearing Housing | Cast Iron, ASTM A48, CL30 to 40 |
| Shaft | 400 Series Stainless Steel |
| Impeller | Gray Cast Iron, ASTM A48, CL30 to 40 |

| Component | Materials of Construction |
|---|---|
| **Final Effluent Water Pumps** | |
| Impeller Wear Ring | Stainless Steel 400 Series, BHN 300 to 350 |
| Casing Wear Ring | Stainless Steel 400 Series, BHN 400 to 450 |
| Fasteners | AISI Type 316L Stainless Steel |
| O-Rings | Nitrile |
| Control Panel | Type 316 Stainless Steel |
| Foot-Mounted Discharge Connection Elbow | Cast iron conforming to ASTM A48 Class 30 or 35 |
| Guide Bars and Brackets | Type 316L Stainless Steel |

## 2.05 COMPONENTS

A. Impeller

1. Impeller Type: One-piece, single-suction, enclosed or semi-open, non-clogging, multiple-vane, solids-handling, mixed flow type.

2. Impeller Construction

a. Solids Passage

1) Impeller shall be designed with smooth flow passages to pass a spherical solid of the specified size and to prevent clogging by stringy materials.

2) Impeller shall handle solids of the specified sphere size, fibrous materials, heavy sludge, and other matter found in normal wastewater applications.

b. The impeller shall be bolted, keyed and locked to the pump shaft at the factory. Adhesive or friction type fits are not acceptable.

c. Impeller shall be coated with the same system applied to the interior of the casing.

d. Impeller Balancing: Dynamically balanced

B. Casing/Volute

1. Type

a. End suction, side discharge construction

2. Construction

    a. The volute shall be single piece, non-concentric design.

    b. Pump shall be designed with a pullout assembly so that the impeller can be withdrawn.

    c. Casing shall be equipped with removable suction cover which can be removed for access to the impeller.

    d. All non-stainless steel metal surfaces coming in contact with the pumped media shall be protected by a factory applied spray coating.

3. Mounting:

    a. Side discharge shall be equipped with foot mounted discharge connection elbow and integral sliding rail system.

4. Solids Passage

    a. Passages shall have smooth unobstructed passages for solids. Volute shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller.

    b. Passage Size: Large enough to pass a spherical solid of the specified size.

    c. Cleanouts

        1) Pump volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump.

        2) Provide cleanout handhole near cutwater.

        3) Cleanout cover shall be removable.

        4) The inner contours of the handhole cover shall match the contours of the casing in which it fits.

    d. Flanges: Integrally cast ANSI Standard flat faced flange with 125-lb drilling,

5. Lifting: Casing/Volute shall be provided with lifting bolts and eye lugs for installation and maintenance of the pumps.

C. Wearing Rings

1. Wearing rings shall be provided on casing and impeller.

2. Wearing rings and fasteners shall be galvanically compatible with casing and impeller materials and resistant to corrosion and erosion by the pumped fluid.

3. Impeller wearing ring shall be approximately 50 Brinell softer than casing wearing ring.

4. A wear ring system shall provide efficient sealing between the volute and impeller.

5. Rings shall be drive fitted to the volute inlet and heat-shrink fitted to the impeller.

D. Shaft

1. Diameter: Sufficiently large in diameter to safely transmit the maximum torque developed by the drive unit and of such design as to provide a rigid support for the impeller and to prevent excessive vibration.

2. Construction: The shaft shall be heat treated, turned, ground, and polished over its entire length and shall be provided with keyways on both ends.

E. Bearing Housing & Bearings

1. Type: Permanently lubricated, radial and thrust bearing anti-friction ball or tapered roller

2. ABMA L10 Bearing Life (at all points along the usable portion of the pump curve at maximum pump speed): Comply with scheduled herein.

3. Quantity: Two per pump

4. Construction

a. Bearing housing shall fully enclose the bearings to prevent entrance of contaminants and shall be designed to provide for axial adjustment of rotating assembly.

b. Bearing housing shall be designed with a machined self-centering fit with the housing.

c. Bearing Lubrication: Bearings shall be permanently lubricated.

d. Comply with Section 46 00 00 – Equipment General Provisions.

F. Sealing of Mating Surfaces

1. All mating surfaces where watertight sealing is required shall be machined and fitted with O-rings.

2. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without the requirement of a specific torque limit.

3. Secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall not be acceptable.

G. Lifting System and Discharge Connection

1. For wet pit installations, provide permanently installed slide rail mounting systems for each pump as shown on the drawings and as specified herein.

2. Slide rail system shall facilitate pump removal from the wet pit for inspection or service without entering the pit or disconnecting piping.

3. The pump shall be provided with a foot mounted discharge connection elbow permanently installed in the wet well along with the discharge piping.

4. The discharge connection elbow shall be constructed with a 125-lb ANSI standard flat faced flange.

5. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple downward motion of the pump.

6. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by the guide bar(s) and pressed tightly against the discharge connection elbow to provide positive sealing under all conditions.

7. The entire sliding rail system shall be designed to safely withstand all stresses imposed thereon by vibration, torque, shock and all possible direct and eccentric loads. No portion of the pump shall bear directly on the floor of the wet well.

8. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be of a conservative size adequate for the intended use. The guide bars shall not support any portion of the weight of the pump.

9. All anchor bolts, lifting bolts, eye lugs and lifting cable, etc. necessary for a complete installation and maintenance of the pump shall be constructed of the scheduled material and shall be adequately designed for its intended use.

10. All metal to metal interfaces where movement might occur shall be non-sparking.

## 2.06 STRUCTURAL STEEL

A. Comply with Section 43 20 00 – Pumps – General.

## 2.07 DISSIMILAR METALS

A. Comply with Section 43 20 00 – Pumps – General.

## 2.08 GALVANIZING

A. Where applicable, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

## 2.09 APPURTENANCES

A. Shaft Seals: Shaft sealing shall be accomplished by one of the methods in the following schedule.

1. Seal Chamber

    a. Mechanical seals shall run in a lubricant-filled chamber to provide constant lubrication.

    b. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity.

    c. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.

    d. The seal system shall not rely upon the pumped media for lubrication.

2. Seal Lubricant

    a. Seal lubricant shall be:

        1) Environmentally safe, non-toxic

3. Shaft Seal – Pump Side

    a. The lower, primary seal unit, located between the pump and the lubricant chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings.

    b. The lower seal shall be independent of the impeller hub.

4. Shaft Seal – Motor Side

    a. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings.

5. Configuration

   a. Each seal interface shall be held in contact by its own spring system.

   b. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter-clockwise direction of rotation without damage or loss of seal.

   c. No external source of seal cooling or lubrication water shall be required.

6. The following seal types shall not be considered acceptable nor considered to be equal to the dual independent seal specified:

   a. Shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces.

   b. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

B. Shaft Seal Schedule

**Shaft Seal Schedule – 43 25 13 - 04**

| | **Final Effluent Water Pumps** |
|---|---|
| **Parameter** | **Type/Material** |
| Shaft Sealing Arrangement | Dual Mechanical Seal |
| Seal Flush Source / API Flush Plan | None |
| Lower Seal Unit – Seal Face Material | Tungsten Carbide and/or Silicon Carbide |
| Upper Seal Unit – Seal Face Material | Carbon, Tungsten Carbide, and/or Silicon Carbide |
| Metallic Components | Type 316 Stainless Steel |
| Flexible Components | EPDM or Buna-N |

C. Pressure Gauges: Provide pressure gauges as indicated on the drawings and as specified under Section 43 20 00 – Pumps – General.

D. Gauge taps shall be provided on the discharge piping of the vertical submersible pumps in a location as directed by the Engineer. Gauge taps shall be threaded corporation stops, conforming to the requirements of Section 40 05 00 – Basic Mechanical Requirements. Gauges shall be as specified in Section 40 73 13 – Pressure and Differential Pressure Gauges.

E. All anchor bolts, lifting bolts, eye lugs, etc. necessary for complete installation and maintenance of the pump shall be furnished by Supplier and constructed of Type 316 stainless steel and shall be adequately designed for its intended use.

## 2.10 ELECTRICAL AND CONTROL REQUIREMENTS

A. Comply with Specification Section 43 20 00 – Pumps – General.

B. Electrical and Instrumentation Requirements and Pump and Motor Monitoring and Protection Instrumentation:

**Schedule – 43 25 13 - 05**

| **Service** | **Final Effluent Water Pumps** |
|---|---|
| **Motors** | |
| Type | Close Coupled |
| Rating | 460V, 3 ph, 60 Hz |
| Maximum Rated Horsepower | 75 |
| Maximum Speed, rpm (Nominal) | 3,600 |
| Enclosure | Submersible |
| Insulation | Class H |
| Inverter Duty | Yes |
| Service Factor | 1.10 |
| Bearing Thermal Protection | No |
| Motor Speed Control | VFD |
| Motor Winding Temperature Protection | Temperature Switches |
| Motor Bearing RTDs | No |
| Motor Bearing Vibration | No |
| **Instrumentation** | |
| Pump Bearing RTDs | No |
| Pump Bearing Vibration | No |
| Moisture Sensor / Leak Detection | Yes |
| Packaged Control Panel | Yes |
| Starter Type | VFD |

| Service | Final Effluent Water Pumps |
|---|---|
| Cooling Jacket | No |
| Rated Starts Per Hour, Minimum | 10 |

1. The pump shall be provided with the following protective devices:

    a. Leak Detection Sensor: Where a leak detection sensor is required by this specification, the pump manufacturer shall provide a leak detection sensor.

    b. Motor High Temperature Switches

        1) The pump manufacturer shall provide protection relay(s) capable of accepting the inputs from the leak detection sensor and motor temperature switches for monitoring and protection of the pumps. The relay(s) shall be installed inside the pump control panel specified herein. Seal leakage and overtemperature protection relay shall be Mini-CAS by Xylem/Flygt or equivalent by or equal pump manufacturer.

C. Submersible Motors

1. All electrical appurtenances shall be rated for installation in classified areas as indicated in the Pump Schedule.

2. Motors shall conform to all applicable parts of Section 26 05 60 – Low-Voltage Electric Motors. The pump motor shall be designed for operation with the voltage, frequency and phase electrical characteristics scheduled herein. See schedule for motor horsepower. Motors shall be mounted on each pump and shall conform to the latest applicable NEMA, IEEE, and ANSI standards for submersible service. The motors shall be rated for continuous duty with a minimum service factor as required by schedules herein.

    a. Type: Squirrel-cage induction, housed in a watertight chamber.

    b. The stator winding and stator leads shall be moisture resistant.

    c. Motor Insulation: Motor insulation shall be as scheduled herein.

    d. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall not be allowed.

    e. Starts Per Hour: The motor shall be guaranteed for continuous unsubmerged duty, capable of sustaining a minimum scheduled starts per hour without overheating.

f. Motor Bearings: The motor shall be provided with pre lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon it under all operating conditions.

g. All motors shall be housed in enclosures specifically designed for submersible pump application.

3. Cable Entry Water Seal

a. The cable entry water seal design shall insure a watertight and submersible seal without specific torque requirements.

b. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by stainless steel washers all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate gaining access through the pump top. The junction chamber containing the terminal board shall be sealed from the motor by an elastomer compression seal O-ring. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to the terminal board and thus perfectly leak proof. Each pump shall be equipped with separate terminal board that totally isolates the incoming power supply from the pump motor.

c. An acceptable alternate cable entry seal shall include cable leads shall enter at the top of the motor and shall allow the cable-to-motor connection to be accomplished in the field without soldering. All power and control lead wires shall be double sealed as they enter the motor in such a manner that cable-wicking will not occur. This sealing system shall consist of a rubber grommet followed by epoxy that is high in adhesive qualities and has a low coefficient of expansion. Each conductor shall have a small section of insulation removed to establish a window area of bare wire and each wire shall be untwisted and surrounded by epoxy potting material. A cable strain relief mechanism shall be an integral part of the sealing system. The cable sealing system shall be capable of withstanding an external pressure test of 1,200 psi as well as a cable assembly pull test as required by Underwriters Laboratories. Power and control leads shall be terminated on a sealed terminal board. The terminal board and its bronze lugs shall be O-ring sealed.

D. Pump Cables

1. Cable Length

a. Power and control cables between the pumps and the control panel shall be provided by the pump manufacturer who shall be responsible for reviewing the drawings as necessary to determine the required cable length.

b. All pumps for the same application shall be provided with the same length of cable.

c. No splices shall be allowed unless specifically called for in the electrical drawings.

2. Pump Cable Materials: PVC or oil resistant chloroprene rubber jacketed type SPC cable suitable for submersible pump applications.

3. Sizing

a. In accordance with NEC and ICEA standards

b. Cords shall be MSHA approved.

4. Stainless steel strain relief connectors shall be furnished for all cables.

E. Level Elements

1. Float switch(es) shall be provided with the pump controls as shown on the Drawings.

2. Float switch(es) shall comply with requirements specified under Division 40 – Process Interconnections.

3. Float switches shall be set and shall operate according to the pump schematic and installation details shown on the Drawings and as specified herein.

F. Furnish VFDs for the pumps in accordance with Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers. The pump manufacturer/supplier shall be responsible for providing a complete working system.

1. The pump VFD shall be located inside the Compressor Building Electrical Room and shall be furnished with a NEMA 1 enclosure. The short circuit current rating of the VFD shall be minimum 42kA RMS symmetrical at 480VAC.

2. VFD shall have the following front-mounted devices:

a. Speed control potentiometer or HMI

b. Pilot lights for the following conditions:

1) Run status

2) Overload

3) VFD Fault

4) Pump Fault

c. VFDs shall accept dry contacts from Final Effluent Water Pump Station Packaged Control Panel (VCP27110):

1) Run Command

2) Stop Command

3) Pump Fault

d. VFDs shall accept the following hardwired commands from the plant control system:

1) Speed Control (4-20mA)

e. VFDs shall have the following dry contacts for remote indication:

1) Run status

2) In Remote status

3) VFD Fault alarm

4) Overload alarm

f. VFDs shall have the following 4-20mA outputs for remote indication:

1) Speed Feedback

2) Pump Current (4-20mA)

## 2.11 CONTROL PANEL

A. Provide control panels, electrical components, instrumentation and wiring for a complete, functional system.

B. The equipment manufacturer/supplier shall provide control panels in accordance with Section 46 07 01 – Packaged Control Panels and as shown on the Drawings.

1. One system control panel for the Final Effluent Water Pump Station

C. Final Effluent Water Pump Station Packaged Control Panel (VCP27110)

1. The manufacturer shall incorporate all necessary devices in the control panel to completely control the equipment and instruments at the Pump Station, including but not limited to submersible pumps and level switches.

    a. The control panel shall be responsible for control of remotely mounted VFDs.

    b. The control panel shall be mounted where shown on the Drawings. All components factory tested as a fully operational component.

    c. The control panel shall not include 480V, 3-phase power.

2. Control Panel Features

    a. Wall-mounted, NEMA 4X, Type 316L stainless steel

    b. Contains equipment for control logic described as follows

3. Power Supply: 120V, single-phase. Provide panel with main circuit breaker disconnect.

4. The panel shall have the following front-mounted control devices:

    a. CONTROL POWER “ON” pilot light

    b. ALT/1-2/2-1 duty/standby selector switch

    c. DUTY RUNNING pilot light

    d. STANDBY RUNNING pilot light

    e. OFF pilot light

    f. HAND-OFF-AUTO (H-O-A) selector switch for each pump

    g. RUN pilot light for each pump

    h. FAULT alarm pilot light for each pump.

    i. OVERLOAD pilot light for each pump.

    j. HIGH TEMPERATURE pilot light per pump

    k. HIGH MOISTURE pilot light per pump

    l. VFD IN REMOTE pilote light per pump

    m. VFD FAULT pilot light per pump

n. RESET pushbutton for each pump

o. Elapsed runtime meter for each pump

p. LOW LEVEL pilot light

q. ALARM BEACON

r. ALARM HORN

5. Remote Indication and Alarming

a. The panel shall have the following dry contacts for remote indication. Alarm contacts shall be normally closed. Status contacts shall be normally open.

1) RUNNING status for each pump

2) HIGH MOISTURE alarm for each pump

3) HIGH TEMPERATURE alarm for each pump

4) OVERLOAD alarm for each pump

5) IN AUTO status for each pump

6) COMMON FAULT for each pump

7) LOW LEVEL alarm

6. Remote Control

a. The panel shall have the following commands from dry contacts external to the panel:

1) RUN COMMAND for the Pump Station

7. System Operation

a. General

1) When the field H-O-A switch is in the HAND position, the pump shall run.

2) When the field H-O-A switch is in the OFF position, the pump shall not run.

3) When the field H-O-A switch is in the AUTO position, the control panel shall control the pumps.

a) Start/Stop: When controlled automatically, the pumps shall operate on a Duty/Standby sequence. The Duty pump will be called to run the control panel receives a PUMP STATION RUN command from the plant PLC.

b) Speed Control: When controlled automatically, the duty VFD shall be controlled to provide the requested flow rate. Speed command and feedback signals will be direct to the plant PLC and not routed through the control panel.

c) Interlocks: LOW LEVEL float switch

## 2.12 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following for each series of pumps.

**Spare Parts Schedule – 42 25 13 - 06**

| | **Final Effluent Water Pumps** |
|---|---|
| **Component** | **Quantity** |
| Set of lower and upper wearing rings | 1 |
| Set of motor and pump bearings | 1 |
| Complete mechanical shaft seal assembly (upper and lower) | 1 |
| Sets of gaskets and O-ring seals | 2 |

## 2.13 EQUIPMENT IDENTIFICATION

A. Comply with Section 43 20 00 – Pumps – General.

## PART 3 – EXECUTION

### 3.01 SHOP TESTING

A. Factory testing shall be in accordance with Section 43 20 00 – Pumps – General, and shall include:

**Shop Testing Schedule – 43 25 13 - 07**

| | Final Effluent Water Pumps |
|---|---|
| Hydraulic Performance Testing | Yes |
| Witnessed Performance Testing | No |
| Certified Performance Curves | Yes |
| Vibration Testing | No |
| Mechanical Test | No |
| String Test | No |
| NPSH Test | No |
| Hydrostatic Test | No |
| Casing Hardness Test | No |

1. Impeller, motor rating and electrical connections shall be checked.

2. Shop testing shall be in accordance with current applicable Hydraulic Institute Standards.

### 3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

B. Storage of equipment shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

## 3.03 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 43 20 00 – Pumps – General. For each series of pumps, field services shall include the following site visits:

**Site Visits Schedule 43 25 13 - 08**

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 2 |
| Startup and Training | 1 | 2 |

## 3.04 INSTALLATION

A. Install pump in strict accordance with manufacturer's recommendations and Section 43 20 00 – Pumps – General.

## 3.05 ALIGNMENT [NOT USED]

## 3.06 FIELD TESTING

A. Field testing shall be in accordance with Section 43 20 00 – Pumps – General, and shall include:

**Field Testing Schedule 43 25 13 - 09**

| | Final Effluent Water Pumps |
|---|---|
| Field Performance Testing | Yes |
| Vibration Testing | No |
| Natural Frequency "Bump" (Impact) Test | No |

## 3.07 FAILURE OF EQUIPMENT TO PERFORM

A. Comply with Section 46 00 00 – Equipment General Provisions.

## 3.08 PAINTING

A. Comply with Section 46 00 00 – Equipment General Provisions.

B. Comply with Section 09 90 00 – Painting.

**END OF SECTION**

# SECTION 46 00 00
# EQUIPMENT GENERAL PROVISIONS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified, as shown on the Drawings, and as required for a complete and operable system.

B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.

D. The complete installation shall be free from excessive vibration, cavitation, noise, oil leaks, and water leaks.

E. The requirements of this section shall apply to equipment furnished under Divisions 40, 41, 43, and 46.

F. Comply with reference specifications, codes and standards as specifically modified, complimented, and supplemented herein.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – References along with those identified herein and in other individual Specification Sections.

1. AISC

2. ANSI/ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings

3. ANSI/ABMA 11 – Load Ratings and Fatigue Life for Ball Bearings

4. ANSI/ASME B29.10 – Heavy Duty Offset Sidebar Power Transmission Roller Chains and Sprocket Teeth

05-23-2023

5. ASA/ANSI S2.75 – Shaft Alignment Methodology

    a. Part 1: General Principles, Methods, Practices, and Tolerances

    b. Part 2: Vocabulary

    c. Part 3: Alignment of Vertically Oriented Rotating Machinery

    d. Guidelines and recommendations included in ASA/ANSI S2.75 shall establish and be interpreted as the minimum requirements for acceptance for leveling, grouting and alignment related work.

6. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination

7. AWS D1.1 – Structural Welding Code – Steel

8. AWS D1.2 – Structural Welding Code – Aluminum

9. EASA Mechanical Reference Handbook

10. ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

B. In the event of conflict between individual Specification Sections and reference specifications, codes and standards, the more restrictive criteria shall govern.

## 1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data

1. Comply with Section 01 33 00 – Submittals Procedures

2. Fabrication information

B. Provide submittals identified in individual equipment Specification Sections in addition to the submittals identified herein.

C. Shop Drawings shall include the following information in addition to the requirements of Section 01 33 00 – Submittal Procedures and shall include the following additional information:

1. Equipment name, identification number and Specification Section number.

2. Performance characteristics and descriptive data, including but not limited to capacity, power, speed, torque, and efficiency.

3. Detailed equipment dimensional drawings and setting plans including but not limited to:

    a. General cutaway sections

    b. Materials of construction

    c. Dimension of shaft projections

    d. Shaft and keyway dimensions

    e. Shaft diameter

    f. Shaft connection details

    g. Dimension between bearings

    h. General dimensions of equipment

    i. Anchor bolt locations

    j. Forces

    k. Assembly views

    l. Weights: Provide weight of entire equipment assembly, including motor and base weight of individual major subassemblies. Indicate the weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.

    m. Rotating assembly technical information and illustration.

    n. Drawings shall identify each component by tag number to which the catalog data and detail sheets pertain.

    o. Drawings showing the location and type of all equipment, system components, supports, hangers, foundations and the required clearances to operate and maintain equipment, valves and system components in a code compliant, safe and ergonomic manner. Drawings shall show clearances reserved for walking access around all sides, for opening access doors fully, for visual inspection for condition monitoring, and for the performance of maintenance tasks including but not limited to changing filters, replacing belts, maintaining lubrication levels, predictive maintenance and performing diagnostic functions.

4. Drive and motor data as required by Division 26 – Electrical. Complete motor data shall include but not be limited to size, make, type and characteristics along with wiring diagrams. Where equipment and motor speeds are to be regulated by

variable speed drives, the Contractor shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit equipment, shafting, coupling, motor and variable speed drive shop drawings.

5. Bearings

    a. Information on bearings including but not limited to: type, size, materials of construction.

    b. Bearing life calculations including but not limited to: basic dynamic load rating, static load rating, rating life, ABMA L10 reliability (expressed in hours of bearing life) and bearing system life.

6. Gear box design and performance criteria and AGMA service factor, including but not limited to the following:

    a. Thermal horsepower rating

    b. Bearing type

    c. Actual gear ratio

    d. Forced Lubrication System: Provide description of equipment, system and instrumentation including but not limited to flow meter, pressure switches, etc.

    e. Gear tooth finish quality

7. Piping schematics.

8. Equipment protective device details and connection diagrams.

9. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.

10. A list of spare parts and special tools to be provided.

11. Information on equipment appurtenances including couplings, shaft guards, v-belt drive systems, etc.

12. All additional information required to demonstrate conformance with the equipment Specification Sections.

13. Results of critical speed analyses, structural, lateral, and torsional dynamic analyses as required herein and in the individual Specification Sections.

14. Warranty documentation including statement of duration of warranty period, contact phone numbers, and contact addresses for warranty issues.

15. Shipment, delivery, handling, and storage instructions.

16. Installation instructions

17. Manufacturers literature and brochures

18. Materials of construction and associated specifications (e.g., AISI, ASTM, SAE), including grade and type.

19. Anchor design in accordance with Section 05 05 23 – Metal Fastening.

20. Intermediate shafting design, including but not limited to general arrangement drawings, engineering data, materials of construction, recommended angular offsets (for cardan universal jointed shafts), and shaft critical speed analyses (including 1st, 2nd, and 3rd critical speed analysis).

21. Coatings: Coating system data and description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

22. Pre-commissioning lubrication oil flushing plan developed by a machinery lubrication specialist, specifically for each piece of lubricated equipment. Plan shall identify, describe procedure and demonstrate data-based approach to demonstrating achievement of lubricant cleanliness via flushing. Level of lubricant cleanliness shall be as required by equipment manufacturer's written recommendations.

23. Equipment installation lists.

24. Equipment specific requirements for levelness, plumbness, flatness, coplanarity and coplanar surface deviation.

## 1.04 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 61 00 – Product Requirements and Options

## 1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 78 23 – Operation and Maintenance Data

B. Comply with Section 01 78 43 – Spare Parts and Extra Materials:

1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

2. Submit complete list of spare parts, extra stock materials, maintenance supplies and special tools required for maintenance for one year with unit prices and source of supply. Indicate number/quantity specified and furnished, manufacturer, part number, and description.

C. Comply with Section 01 79 00 – Instructions to Owner's Personnel.

D. Lubrication Information

1. Comply with Specification Section 01 78 23 – Operation and Maintenance Data.

2. Complete lubrication instructions and lubricant schedule, including manufacturer's recommended lubricant. All lubricants shall be food grade, NSF 61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application.

## 1.06 QUALITY ASSURANCE SUBMITTALS

A. Factory testing plan

B. Factory Test Results shall be submitted and approved prior to shipment of equipment.

C. Field testing plan

D. Comply with Section 01 75 00 – Check Out and Start Up Procedures.

E. Alignment Report

1. Alignment reports shall contain numerical values to express offset and angular alignment and all other parameters documented in ANSI/ASA S2.75.

2. Alignment reports shall be submitted immediately after each of the following activities have been completed:

a. Preliminary alignment

b. Final alignment (at both ambient and operating temperatures)

c. Re-check of alignment

F. Preliminary field test data

G. System field quality control testing

H. Final field test data

I. Certified test reports

## 1.07 GENERAL INFORMATION AND DESCRIPTION

A. All parts of the equipment furnished shall be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.

B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.

C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.

D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.

E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc. shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.

H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

I. All equipment or removable components greater than 100 pounds shall have lifting lugs, eyebolts, etc. for ease of lifting, without damage or undue stress exerted on its components.

J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.

K. Code Compliance, safety and ergonomics for operating and maintenance personnel accessing equipment shall be considered during shop drawing development, fabrication, and installation. Items to consider include but are not limited to clearances reserved for walking access around all sides, for opening access doors fully, for visual inspection for condition monitoring, and for the performance of maintenance tasks including but not limited to changing filters, replacing belts, maintaining lubrication levels, predictive maintenance and performing diagnostic functions.

## 1.08 EQUIPMENT WARRANTIES

A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options and Section 01 75 00 – Checkout and Startup Procedures. Warranty requirements are supplementary to the individual equipment Specification Sections.

## 1.09 DEFINITIONS

A. Comply with specification Section 01 42 00 – References.

B. Refer to the specified reference specifications, codes and standards for definitions applicable to this Section. Additional definitions are included hereafter.

C. Chockplate: A solid steel (or alloy steel) plate with a machined top surface that is grouted to a concrete foundation to support and maintain alignment of a machinery structural steel base plate.

D. Equipment Train: Two or more rotating equipment machinery elements consisting of at least one driver and one driven element joined together by a coupling.

E. Mounting Plate: A device used to attach equipment to concrete foundations; includes base plates, soleplates, and chockplates. A mounting plate is a base-support mechanism for the attached machinery and all individual pieces of machinery are expected to be removable from the mounting plate as a single assembly.

F. Operating Temperature (Thermal) Alignment: A procedure to determine the actual change in relative shaft positions within a machinery train from the ambient (not running) condition and the normal operating temperature (running) condition by taking measurements from start-up to normal operating temperature while the machine(s) is (are) operating, or after the shafts have been stopped but the machines are still near operating temperature.

G. Preliminary Alignment: The aligning of two adjacent machinery shafts to ensure that final alignment can be achieved without being bolt bound. This is accomplished before grouting (for horizontal machines) and the measurement of piping strain on the machinery.

H. Soleplate: A solid steel (or alloy steel) plate with a machined top surface that is grouted to a concrete foundation to support and maintain alignment of machinery.

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. All like components within a piece of equipment shall be provided by the same manufacturer.

B. Base Plates

1. Top surface of mounting plates shall be machined in locations where equipment supports/feet will contact the plate.

2. Equipment contact points shall be flat and parallel within ASA/ANSI S2.75 tolerances or 0.002 inch per foot, whichever is more stringent, and within related tolerances.

3. There shall be no paint where equipment supports or feet contact mounting plate.

4. Mounting plate shall be sufficiently rigid to avoid bending or flexing when equipment is installed.

### 2.02 ANCHORS AND SUPPORTS

A. Comply with the following Specification Sections:

1. Section 05 05 23 – Metal Fastening

2. Individual equipment Specification Sections

B. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and templates shall be used by the Contractor when required in the detailed equipment Specification Sections.

C. Anchor Bolts and Fasteners

1. Anchor bolts shall be designed and provided by the Contractor in accordance with Section 05 05 23 – Metal Fastening, and with the individual equipment Specification Sections.

2. All anchor bolts shall have at least the minimum diameter as required by Section 05 05 23 – Metal Fastening.

3. All anchor bolts, guard bolts, washers, clips, clamps, fasteners, and leveling plate pads, nuts, shims, and jack bolts of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specification Sections.

4. Undercutting of anchors or fasteners shall not be permitted.

D. Pipe sleeves as a means for adjusting anchor bolts shall be provided where indicated in the contract documents or required by the equipment manufacturer.

E. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 4 inches high, unless otherwise shown on the Drawings, and shall be doweled.

## 2.03 DEFAULT MATERIALS

A. Equipment shall be constructed out of the materials specified in respective individual pumping Specification Sections. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended.

## 2.04 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05 12 00 – Structural Steel.

B. All materials shall conform to applicable provisions of the AISC specifications for the design and fabrication of structural steel, and to pertinent ASTM standard specifications.

## 2.05 DISSIMILAR METALS

A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

## 2.06 GALVANIZING

A. Where required by the equipment Specification Sections, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

## 2.07 STANDARDIZATION OF GREASE FITTINGS

A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

## 2.08 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances including, but not limited to, motors, panels, conduit, and wiring, etc. specified in the equipment Specification Sections shall comply with the applicable requirements of Division 26 – Electrical and the latest National

Electric Code. Motor starters and controls shall be furnished and installed under Division 26 – Electrical and Division 40 – Process Interconnections unless otherwise specified in the individual equipment Specification Sections.

B. In the individual equipment Specification Sections, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 26 unless otherwise specified in the equipment Specification Sections. Wherever variable speed drives (VSDs) are specified the same requirements as for VFDs shall apply.

D. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment Specification Sections.

## 2.09 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

A. Accessories, spare parts, and special tools shall be provided in accordance with Section 01 78 43 – Spare Parts and Extra Materials.

## 2.10 EQUIPMENT IDENTIFICATION

A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with:

1. The manufacturer's name

2. Year of manufacture

3. Serial number

4. Principal rating data such as (for example):

    a. Capacity

    b. Pressure

    c. Horsepower

    d. Speed

B. Each piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1 (RWP-1)". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

C. Nameplates shall not be painted over.

## PART 3 – EXECUTION

### 3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project site until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.

C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.

D. If required by the individual equipment Specification Sections, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified 10 working days before shop testing commences. Expenses are to be paid by Owner.

E. Shop testing of electric motors shall conform to:

1. Section 26 05 60 – Low-Voltage Electric Motors

2. Section 26 05 00 – Basic Electrical Requirements

### 3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery, and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

B. Storage of equipment and materials shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

C. Shipping plans shall include consideration for protecting bearings and/or other rotating equipment from chatter damage.

D. Any equipment shipped to site that needs further attention shall have a WARNING tag affixed to it with indication of the action that should be taken in preparation for startup (e.g., Final Lubrication, Mechanical Seal not in final position).

## 3.03 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's field services shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.

C. Services of the Technical Representative will require a minimum of two site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment Specification Sections.

D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of their inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

E. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment Specification Sections, the Technical Representative shall also supervise the installation of the equipment.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the

installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the Specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: Training shall be provided in accordance with Section 01 79 00 – Instruction of Owner Personnel.

5. Services after Startup: Where required by the individual equipment Specification Sections, the Technical Representative shall return to the project site 30 days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that their equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful 30-day operating period.

F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specification Sections are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

## 3.04 INSTALLATION

A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished to the Engineer's field representative at least 1 week prior to installation.

B. The Engineer’s field representative shall witness all activities involved with equipment installation.

C. The Contractor shall have on hand personnel, construction equipment, and machinery of capacity to facilitate the work and to handle all emergencies encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled insofar as practical.

D. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.

E. All equipment sections and loose items shall be match-marked prior to shipping.

F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

G. Leveling and Grouting

1. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/-1/16 inch except as otherwise specified, required or indicated on the drawings.

2. Base plate Surface Preparation – Prior to setting equipment and grouting, inspect and clean equipment mounting base plates, pads, feet, and frames to remove all grease, rust, paint, and dirt.

3. Wedges (i.e., tapered shims) shall not be used for leveling, aligning, or supporting equipment.

4. General Equipment Leveling

a. Non-Rotating Equipment: Set level to +/-1/16 inch per 10-foot length (0.005 inch per foot) unless manufacturer’s requirements are more stringent.

b. Rotating Equipment: Install, set to the most stringent of the following requirements for levelness, plumbness, flatness, coplanarity and coplanar surface deviation:

1) ASA/ANSI S2.75, comply with tolerance ranges scheduled at the end of this Section

2) Individual equipment Specification Sections

3) Manufacturer's pre-printed written requirements

4) When the equipment manufacturer's pre-printed tolerances are more stringent than those stated in ASA/ANSI 2.75 or more stringent than the individual pump Specification Section, the cost of field machining sole plates or precision grouting sole plates shall be covered by the Contractor.

c. Shims or leveling nuts shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment base plate edges. When grouting is required, equipment shall be shimmed to allow a minimum of 1-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

d. Equipment shall be leveled by first using sitting nuts on the anchor bolts and then filling the space between the equipment base and concrete pedestal with epoxy base plate grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (e.g., shim leveling pumps, chemical grout).

5. Grouting

a. Comply with Section 03 60 00 – Grout.

b. Grout Materials

1) Rotating Equipment: Grout for rotating equipment shall be epoxy base plate grout. Cementitious grouts shall not be accepted for rotating equipment.

2) Non-Rotating Equipment: Grout shall be as per the non-rotating equipment manufacturer's pre-printed written installation instructions and shall be subject to the Engineer's approval.

c. Fill pipe sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

d. Concrete Surface Preparation: Roughen concrete equipment pad surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale.

1) When grouting with cementious grouts is approved, the contact area of the concrete equipment pad shall be saturated with water at least 4 hours prior to grouting, removing excess water ponds.

e. Application

1) Place grout after the equipment base has been set and its initial alignment and level have been approved.

2) Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions.

3) Grout mixture shall be flowable. Dry packing of grout shall not be permitted.

4) Eliminate all air or water pockets beneath the base using a drag chain or rope.

5) Grout voids detectable by tapping the top of the base plate with a hammer shall be grounds for removal and reinstallation of the work.

f. Finishing: Point the edges of the grout to form a smooth 45-degree slope.

g. After cementious grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

h. Level Verification. After grout has cured, and immediately prior to final drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

6. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

**3.05 ALIGNMENT**

A. For equipment that requires field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the equipment and motor prior to making piping connections or anchoring the equipment base. Alignment shall be as specified herein.

B. Rotating Equipment Shaft Alignment: Assembled equipment shafts shall be set to comply with the most stringent of the following tolerance requirements for shaft runout and shaft-to-shaft alignment tolerances expressed in angle at flex plane, in offset and angularity and/or in offset per tolerance plane separation:

1. ASA/ANSI S2.75, comply with tolerance ranges scheduled at the end of this Section

2. Individual equipment Specification Sections

3. Manufacturer’s pre-printed written requirements

C. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

D. Sprocket and Sheave Alignment

1. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI/ASME B29.10.

2. Drive and driven sheaves shall lie in the same plane. The sum of parallel and angular sheave misalignment measured across the span length of the belt and angular misalignment perpendicular to the belt span length shall each not exceed 0.5 degree or the belt manufacturer’s recommendation whichever is more stringent.

E. Belt Tensioning: Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.

F. Thermal/Mechanical Growth: Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.

G. Rotating Shaft Alignment

1. Measurement devices/fixtures shall be set up on the driver and driven machine, or machine shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.

2. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.

3. Final alignments shall be performed utilizing laser alignment tools unless otherwise approved by the Engineer.

4. Alignment Steps: Each of the following alignment steps are required in all instances, including but not limited to, all vertically and horizontally mounted drivers:

a. Preliminary alignment is when uncoupled. Preliminary Alignment (at ambient temperature):

1) Perform prior to grouting and piping connections.

2) Check shaft straightness (runout).

3) Correct for soft foot.

b. Final alignment method is when coupled. Final alignment (at ambient temperature):

1) Perform after grouting and piping connections have been completed.

2) Check for pipe strain.

3) Alignment shall be within tolerances.

c. Final alignment method is when coupled. Final alignment (at operating temperature after 1 hour of continuous operation):

1) Check for pipe strain.

2) Alignment shall be within tolerances (coupled).

d. Re-check alignment (at operating temperature):

1) After a minimum of 24 hours of run time

2) Alignment shall be within tolerances (coupled)

## 3.06 FIELD TESTING

A. Field testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer’s representative.

C. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:

a. Verify that the equipment is free from defects.

b. Check for alignment as specified herein.

c. Check for direction of rotation.

d. Check motor for no load current draw.

2. Contractor shall flush all bearings, gear housings, etc. in accordance with the pre-commissioning lubrication oil flushing plan and manufacturer’s pre-printed written recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.

3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or the Engineer’s assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

D. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.

2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or the Engineer’s assigned representative and the Owner or the Owner’s assigned representative.

3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:

a. Check equipment for excessive vibration and noise.

b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded. The rated motor nameplate horsepower shall not be exceeded when a torque transducer is provided.

c. Recheck alignment where applicable, after unit has run under load for a minimum of 24 hours.

E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.

F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.

G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further

construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc. shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment Specification Sections.

J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

K. Field testing of electric motors shall be in accordance with Section 26 05 60 – Low-Voltage Electric Motors and Section 26 05 00, Basic Electrical Requirements.

## 3.07 VIBRATION TESTING

A. Vibration testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

## 3.08 FAILURE OF EQUIPMENT TO PERFORM

A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.

B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding their having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.

D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all rights, title, and interest in and to said rejected equipment;

provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.

F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

## 3.09 PAINTING

A. The equipment and motor shall be painted. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting requirements shall conform to applicable paragraphs of Section 09 90 00 – Painting.

B. All shop coatings shall be compatible with proposed field coatings.

C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer.

D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

## 3.10 WELDING

A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 or AWS D1.2, as applicable.

B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 or AWS D1.2, as applicable.

C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with AWS A2.4 and special conditions, as shown by notes and details.

**Schedule 46 00 00 – 01 – Applicable Tolerance Range**

| Equipment Horsepower | ANSI/ASA S2.75 Quality Grade Tolerance Range |
|---|---|
| <= 25 HP | Minimal |
| > 25 HP and < 100 HP | Standard |
| >= 100 HP | Precision |

Scheduled ANSI/ASA S2.75 Quality grade tolerance range categories relate to ANSI/ASA S2.75 quantified tolerances for: levelness, plumbness, flatness, coplanarity, coplanar surface deviation, shaft runout, shaft-to-shaft alignment, flex plane offset, angularity, and offset per tolerance plane separation.

**END OF SECTION**

# SECTION 46 07 01
# PACKAGED CONTROL PANELS

## PART 1 – GENERAL

### 1.01 THE REQUIREMENT

A. Except as noted, equipment specified in this Section shall be provided under other Divisions. This Section applies only when referenced by other Sections.

B. Design, furnish, install, test, and place in satisfactory operation the control panels with all spare parts, accessories, and appurtenances as specified and as shown on the Drawings.

C. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

D. Either manufacturer's standard or custom panels shall be furnished subject to the requirements of the Contract Documents.

E. Reference Sections

1. Section 26 05 53 – Identification for Electrical Systems
2. Section 26 09 16 – Electric Controls and Relays
3. Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers
4. Section 26 43 13 – Surge Protective Devices
5. Section 40 61 15 – Process Control System Submittals
6. Section 40 63 43 – Programmable Logic Controllers
7. Section 40 78 56 – Isolators, Intrinsically Safe Barriers, and Surge Suppressors
8. Section 43 25 13.10 – Wet Pit Submersible Solids-Handling Pumps
9. Section 46 76 70 – Indirect Thermal Sludge Drying System
10. Section 46 76 42 – Screw Conveyors

## 1.02 CODES AND STANDARDS

A. Control panels and components shall be in conformance with or listed to with the following codes and standards as applicable:

1. IEEE C62.41 – IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

2. ISA

   a. ISA S50.1 – Compatibility of Analog Signals for Electronic Process Instruments

   b. ISA 12.12.01 – Nonincendive Electrical Equipment for use in Class I and II, Division II Hazardous (Classified) locations

3. NEMA

   a. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

   b. NEMA AB 1 – Molded Case Circuit Breakers and Molded Case Switches

   c. NEMA ICS 2 – Industrial Control Devices, Controllers and Assemblies

4. NFPA 70 – National Electrical Code (NEC)

5. UL

   a. UL 50 – Standard for Enclosures for Electrical Equipment

   b. UL 508A – Standards for Safety, Industrial Control Panels

   c. UL 508C – Standard for Power Conversion Equipment

   d. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations

   e. UL 1449 – Standard for Surge Protective Devices

## 1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

012319

3. Proposed Testing Methods and Reports of Certified Shop and Field Tests

4. Manufacturers Startup Certification

5. Operation and Maintenance Manuals

## 1.04 SHOP DRAWINGS

A. Shop drawings shall be provided for all control panels and shall include:

1. Exterior panel drawings with front and side views

2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet

3. Panel area reserved for cable access and conduit entry

4. Nameplate schedule

5. Panel wiring diagrams showing power, signal, and control wiring including, but not limited to, surge protection, relays, convenience receptacles, lighting, wire size and color coding

   a. Provide complete terminal identification of all field wiring that interfaces with directly to the panel wiring shown. Polarity of analog signals shall be shown at each terminal.

   b. All field wiring shall be shown as a dotted line with signal type clearly identified (power, discrete control, analog, serial communications, fiber optic, etc.).

   c. Panel wiring diagrams shall identify wire numbers, terminal numbers, and project-specific instrument and equipment tag numbers. Wiring diagrams shall show all circuits individually; no common diagrams allowed.

   d. Panel wiring diagrams shall identify grounding requirements.

   e. Interconnecting Wiring Diagrams: Diagrams shall show all component terminal numbers, control panel terminal strip numbers, and external wire, fiber, and cable numbers.

6. For control panels with PLC systems, submit:

   a. System block diagram showing all major components, including processor, input/output cards, power supplies, communications cards, and operator interface terminal (OIT)

   b. Samples of OIT graphics

c. Input/output list that includes point type, tag number of the control element, equipment description, PLC number, PLC terminal identification, rack number, module/slot number, and PLC address

d. Descriptions of software required to program and configure the control systems

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and key notes relating their locations in the panel

2. Product data sheets including complete part number breakdown information

3. Complete technical, material and environmental specifications

4. Enclosure field mounting requirements

5. Enclosure color samples

6. Nameplates and pilot device legend plates

7. Environmental requirements during storage and operation

C. For outdoor panels containing drives or PLC equipment, submit calculations that verify the adequacy of the proposed cooling method.

D. Data Communication with Process Control System: For control panels that have PLCs requiring data communication with the Process Control System, provide submittal data in accordance with Section 40 63 43 – Programmable Logic Controllers. This submittal shall be prepared jointly in conjunction with the Instrumentation and Control System subcontractor.

## 1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions, Section 01 78 23 – Operation and Maintenance Data, and Section 40 61 15 – Process Control System Submittals. The manuals shall include:

1. Instruction books and/or leaflets, including manufacturer standard O&M manuals for all equipment and software

2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements

3. Recommended spare parts list

4. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and during start-up and commissioning

5. Where PLCs or other programmable controllers are provided, include the following in the O&M manuals:

    a. Fully commented and cross-referenced printouts of the final, debugged PLC and OIT programs and identification of all tags and registers

    b. Copies of the unlocked final, debugged PLC and OIT source code files on DVD or flash drive for reloading programs

        1) The exception is the portion of the indirect thermal sludge drying system supplier's (i.e., System Supplier's) PLC source code that contains their intellectual property for screw control. That portion of the source code shall be viewable but may be locked from editing to avoid changes that could potentially cause damage to the indirect thermal sludge drying system.

## 1.06 SOFTWARE DESIGN

A. For control panels that include a PLC, program and configure the PLC in accordance with the requirements of Section 40 63 43 – Programmable Logic Controllers. Coordinate data communications with the Instrumentation and Control System subcontractor.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by the capsule manufacturer. Wrap the completed panel in polyethylene plastic and pack it in a wooden shipping crate with sufficient packing to avoid damage in shipment. Support the base of the shipping crate with cross-members of sufficient strength and clearance to allow handling of the entire crated panel by forklift truck.

## 1.08 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer-recommended spare parts, the Contractor shall furnish the following spare parts for each packaged control panel.

1. One set of fuses of each size provided

2. One relay of each type and size provided

3. Two lamps and lenses for indicating lights for each color provided

4. One indicating lamp socket for each type provided

5. One pilot device (e.g., pushbutton, selector switch) complete with contact blocks and legend plates for each type, size, and rating provided

6. One of each type and size of module for PLC equipment

7. One of each type and size of PLC and equipment power supply

B. The spare parts shall be packed in containers suitable for long-term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.

1. The exception is any spare parts for packaged control panels associated with the indirect thermal sludge drying system supplier's (i.e., System Supplier's) scope of supply under Section 46 76 70 – Indirect Thermal Sludge Drying System. Those packaged control panel spare parts furnished by the System Supplier shall be delivered no later than 2 weeks prior to the start of checkout, startup, and commissioning of the indirect thermal sludge drying system.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

## 1.09 IDENTIFICATION

A. Each control panel shall be identified with the name and identification number indicated on the Drawings (e.g., 97-VCP-1). A nameplate shall be securely affixed in a conspicuous place on each control panel.

# PART 2 – PRODUCTS

## 2.01 GENERAL

A. Provide panels with a UL Listing Mark for Enclosures that states "LISTED ENCLOSED INDUSTRIAL CONTROL PANEL" per UL 508A.

B. All panel components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other

component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.

1. Terminal strips, relays, timers, and similar devices shall not be installed on the inside of doors or on the side walls of panel/cabinet interiors without written permission from the Engineer.

C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.

## 2.02 ENCLOSURES

A. Provide wall mounted or free-standing enclosures as required or as indicated in individual equipment Sections. Unless otherwise indicated free-standing, outdoor enclosures shall be provided with leg kits so that the bottom pan does not sit directly on the concrete pad.

B. In non-hazardous locations, provide the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

| Area Designation | Enclosure Type and Material |
|---|---|
| Indoor Wet Process Area | NEMA 4X, Type 316 Stainless Steel |
| Indoor Dry Process Area | NEMA 12, Painted Steel |
| Indoor Dry Non-Process Area | NEMA 1, Painted Steel |
| Indoor Type 1 Chemical Storage/Transfer Area | NEMA 4X, Fiberglass |
| Indoor Type 2 Chemical Storage/Transfer Area | NEMA 4X, Type 316 Stainless Steel |
| All Outdoor Areas | NEMA 4X, Type 316 Stainless Steel |

C. In hazardous locations, provide the following enclosure type and material of construction or an Engineer- and Owner-approved alternative type and material of construction that includes appropriate purging/pressurization features, dependent upon the classification

of the area in which they are to be installed. Area classifications are indicated on the Drawings.

| Area Classification | Enclosure Type and Material |
|---|---|
| Class 1, Division 1, Group D | NEMA 7, Die Cast Aluminum |
| Class 1, Division 2, Group D | NEMA 7, Die Cast Aluminum |
| Class 2, Division 1, Group F | NEMA 9, Die Cast Aluminum |
| Class 2, Division 2, Group F | NEMA 9, Die Cast Aluminum |

D. Fabricate enclosures from a minimum 14-gauge steel with all seams ground smooth, all corners rounded, and all flat surfaces smooth with no ripples, dimples, or surface imperfections and no screws, bolts, or nuts visible from outside.

1. Unless stainless steel construction is indicated, thoroughly clean and degrease the steel shell before painting. Apply one coat of a rust inhibiting primer and two coats of air-dry enamel or acrylic with flattening agent to produce a smooth semigloss finish.

2. Exterior shall be manufacturer's standard gray or ANSI 61, unless otherwise specified. Interior shall be white enamel.

E. For wall- or rack-mounted enclosures, provide mounting means that is external to the equipment cavity (i.e. with mounting ears or flanges that are welded to the enclosure). Bolts or anchors shall not penetrate the enclosure.

F. Design panels to adequately dissipate heat generated by equipment mounted in the panel.

1. Furnish cooling fans with air filters if required to dissipate heat.

2. For outdoor and NEMA 4X panels provide air conditioning system that utilizes a heat-exchange method that allows for cooling of the enclosure interior without circulating outside air through the enclosure.

3. Panels shall be furnished with an additional control power transformer sized to provide power for the air conditioning system and enclosure space heater

G. Front access door(s) shall be continuously hinged. For free standing enclosures, furnish a three-point latching mechanism. A single point latch is acceptable for wall mounted enclosures with door diagonal dimension less than 18 inches. Provide enclosures with fast operating clamp assemblies requiring tool-less entry. Provide double or multiple doors as required. Wire door mounted devices to stationary components with suitable flexible connections and protection where wiring crosses the hinge.

H. All panels shall be either pad-lockable or have a lock installed in the door handle.

I. In all NEMA 4X enclosures, provide a thermostatically controlled space heater and corrosion inhibitor blocks. Provide NEMA 4X rated devices or mount devices on interior swing-out panel and provide door mounted tempered glass or scratch-resistant polycarbonate viewing window.

J. Provide panel heat calculations used for sizing the air conditioner and heater. A high-temperature switch shall be provided for the panel to indicate panel is overheating

K. In freestanding enclosures, provide a LED light and GFCI duplex receptacle to facilitate service work. The receptacle shall be mounted on the back or side panel within the enclosure.

L. For panels located outdoors or in unheated areas provide a breather and drain equal to Crouse-Hinds ACD and ECD. Provide thermostatically controlled heaters to maintain temperature above 40 degrees Fahrenheit.

M. Where indicated for panels located outdoors, provide stainless steel heat shields of the same material as the associated panel to prevent excess heat inside the panel. Shields shall be provided for the top, back, and both sides of the panel. Shields shall be mounted to provide one-inch air space between the shield and the panel. Each shield shall have the same height and width as the panel side being protected.

N. For all panels located outdoors, provide a full-width sunshield to prevent direct sunlight from shining on any of the operator interface devices. See the Drawings for details.

O. Enclosure Manufacturers

1. Austin Electrical Enclosures

2. nVent Hoffman

3. Saginaw Control and Engineering

4. Or Equal

## 2.03 POWER AND GROUNDING

A. For control panels receiving 120VAC power supply, provide appropriately sized main circuit breaker, single-pole, mounted in the rear of the panel.

B. For control panels receiving 480VAC power supply, provide appropriately sized main circuit breaker mounted in the rear of the panel with external flange-mounted breaker operator mechanism. Interlock the main circuit breaker mechanism with the panel door.

C. Control Power

1. Provide a suitably sized control power transformer where required. Control power transformers shall be fused on both the primary and secondary sides.

    a. For 480V packaged control panels with external control power supplied from the System's uninterruptable power system (UPS) as furnished by the indirect thermal sludge drying system supplier (i.e., System Supplier) in their scope of supply under Section 46 76 70 – Indirect Thermal Sludge Drying System:

        1) Provide a warning sign attached to the panel door that states "DANGER! PANEL WITH TWO POWER SOURCES: MCC-26 AND EXTERNAL UPS".

        2) In addition to the 480V main disconnecting means, provide a disconnecting means inside the panel for the 120VAC circuit from the UPS to allow de-energizing the panel from both power sources.

2. Where indicated for control power to be externally sourced, make provisions to receive and manage this feeder separately from the 480VAC power supply. Provide an appropriately sized main circuit breaker, single-pole, mounted inside the panel.

D. Where applicable, mount an engraved nameplate (white letters on red background) to read "DANGER - This panel is energized by foreign control power sources. Equipment will have energized components with panel disconnect in both on and off positions".

E. Internal panel sub-feeds of 120VAC control power shall be divided into separate circuits protected by properly sized circuit breakers or fuses.

F. The following separate circuit divisions shall be provided:

1. Panel light(s) and panel fans (where used)

2. Receptacle(s)

3. Thermostatically controlled panel heaters (where supplied)

4. Each power supply (including 24V power supplies, power supplies for PLCs, power supplies for fiber optic transceivers, etc.)

5. 120V power to field mounted instruments (each instrument shall be provided with a separate circuit)

6. 120V power to ancillary field mounted equipment (each item of equipment shall be provided with a separate circuit)

G. Provide a 1/4- x 1-inch copper ground bus in the rear of the panel, length commensurate with panels size. Bond to the metal enclosure the panel door, the sub-panel (if present), the power system equipment grounding conductor, and the control and signal circuit grounds.

## 2.04 WIRING

A. Install a minimum of #16 AWG copper, stranded, 600V, extra flexible for all control wiring and minimum #18 AWG copper, twisted, shielded pair for analog signal conductors. Wiring used between equipment within the cabinet and devices mounted on the cabinet door shall be Type MTW and shall be protected from physical damage resulting from door operation. Color code wires as follows:

1. Ground: GREEN
2. Neutral: WHITE
3. Line Conductor (150V or less to ground): BLACK
4. Control (150VAC or Less)
    a. Internally Powered: RED
    b. Externally Powered: YELLOW
5. Control (24VAC): ORANGE
6. DC Voltage
    a. Power (+): RED
    b. Power (-): BLACK
    c. Control: BLUE
7. Analog Signal: BLACK/WHITE or BLACK/RED
8. Intrinsically Safe Circuits: LIGHT BLUE
9. Motor and Equipment Power (480V Line-to-Line): BROWN, ORANGE, YELLOW

B. Mark all wires with approved wire markers at all terminations.

C. Neatly bundle and secure all wiring with plastic ties. Route sub-panel wiring in slotted plastic wireways with snap on covers. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring when operating at differing voltages. Wiring to door-mounted devices shall be bundled together with a

spiral wrap wiring harness that is mechanically fastened at both ends of the harness. Adhesive mounts are not allowed.

D. Where Intrinsic Safety (IS) barriers are required as a means of providing electrical hazardous area protection for the associated field device, all IS barriers and associated IS wiring shall be separated by at least two inches of air space from all regular non-hazardous wiring inside the control panel. Per NEC Article 504-30, grounded metal or other insulated partitions with lesser distance requirements shall be permitted. IS wiring entering the control panel shall be located in dedicated conduits, which also shall be separated from any non-hazardous wiring. IS Barriers shall be located in electrical non-hazardous areas.

E. Conduits containing IS wiring where entering enclosures containing regular, non-IS wiring shall be externally sealed to prevent transmission of gases from hazardous areas. Conduit installation and sealing shall be provided under Division 26 – Electrical.

## 2.05 CIRCUIT BREAKERS

A. 120VAC Circuit Breakers: Molded case, thermal magnetic, 10,000 AIC minimum; Schneider Electric QOU Series, or equal Allen-Bradley, Eaton or General Electric products

B. 480VAC Circuit Breakers: Molded case, thermal magnetic, 65,000 AIC minimum unless indicated otherwise; Schneider Electric PowerPact, or equal Allen-Bradley, Eaton or General Electric products

## 2.06 MOTOR CONTROLLERS

A. Provide combination type motor controllers with motor circuit protectors. Starters shall be rated 65,000 AIC minimum unless indicated otherwise.

B. Variable Frequency Drives (VFDs): As specified in Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers.

1. 6-pulse VFD units shall be provided with input filter or input line reactor and/or integral DC link reactor. Total reactor impedance shall be a minimum of 3% and shall not exceed 5%.

## 2.07 RELAYS

A. Provide control and time delay relays in accordance with Section 26 09 16 – Electric Controls and Relays.

## 2.08 TERMINAL BLOCKS

A. Provide terminal blocks for all field wiring connections to the panel. Provide one terminal for each wire unless terminals are rated for multi-wire terminations. Terminal blocks may be mounted horizontally or vertically and shall be easily accessed from panel door(s).

   1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the subpanel.

   2. Power terminal blocks for conductors #3 and larger shall be bolted directly to the subpanel.

B. Control terminal blocks shall be tubular screw type with pressure plate that will accommodate wire size range of #22 to #8 AWG. Terminal blocks shall be as manufactured by Entrelec Type M 4/6, Phoenix Contact, Weidmuller, Square D, or equal.

C. Control terminal blocks shall be single tier with a minimum rating of 600V and 20A. Separate terminal strips shall be provided for each type of control used (i.e., 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be sufficient quantity of terminals for the termination of all spare conductors.

D. Provide fused terminal blocks as required and where indicated.

E. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

## 2.09 PILOT DEVICES

A. Provide pushbuttons, selector switches, and indicating lights in accordance with Section 26 09 16 – Electric Controls and Relays.

## 2.10 SURGE PROTECTIVE DEVICES

A. Provide a main panel surge protective device (SPD) in accordance with Section 26 43 13 – Surge Protective Devices.

   1. Provide each outdoor control panel with a main power SPD, Type II, with surge current rating of 50kA.

   2. Factory-mount SPDs inside the control panel.

B. Provide surge protection for the following signal circuits in accordance with Section 40 78 56 – Isolators, Intrinsically Safe Barriers, and Surge Suppressors:

1. Analog signal circuits which travel outside of a building

2. Copper-based communication cables which travel outside of a building

## 2.11 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Provide PLCs in accordance with Section 40 63 43 – Programmable Logic Controllers.

## 2.12 NAMEPLATES

A. Provide engraved plastic nameplates to identify the control panel, door-mounted devices, and internal components.

1. Provide a master nameplate giving control panel designation, voltage rating, ampere rating, short circuit rating, manufacturer's name, general order number.

2. Label all devices mounted on the sub-panel with engraved lamacoid name plates, black with white letters.

B. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.

C. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel, Type AHK10324X as manufactured by Hoffman or equal.

D. Control components mounted as part of the assembly, such as fuse blocks, control relays, pushbuttons, switches, and similar devices, shall be suitably marked for identification corresponding to appropriate designations on the manufacturer's wiring diagrams.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

A. Install panels so they are rigidly supported and readily accessible. Select mounting height so that operating handles are not higher than 6.5 feet or lower than 2.0 feet above the floor. Allow complete door swing required for component removal.

1. Install surface-mounted panels on channel with a minimum of four anchors. Do not drill anchors through the enclosure.

2. Install free-standing panels on a 3-1/2-inch concrete pad secured with a minimum of four anchor bolts extending through the pad into the building or structure floor beneath the pad.

B. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal. Do not splice or tap wiring except at device terminals or terminal blocks.

C. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

## 3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests: None required.

2. Certified Shop Tests and Reports

a. Submit description of proposed testing methods, procedures, and apparatus.

b. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

B. Field testing shall be done in accordance with the requirements specified in the General Conditions and Division 01. Conduct field testing as required by the equipment Section.

1. Test data communication with the Process Control System. Verify that the required data exchange has been implemented. Test and verify that general event durations are limited to 2 seconds or less.

C. Acceptance of a shop test does not relieve Contractor from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the Contractor of responsibilities.

D. Certification on materials and records of shop tests necessary for the inspector to verify that the requirements of the Specifications are met, shall be made available to the inspector.

E. Submit signed and dated certification that all of the factory inspection and testing procedures described herein have been successfully performed by the Contractor prior to shipment.

## 3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. Coordinate these requirements with those listed in the equipment Sections. The Contractor shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and startup of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.

B. The manufacturer's technical representative shall perform all startup and field acceptance testing as specified herein.

C. The Contractor shall provide training for the Owner's personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner's personnel in operation and maintenance of all equipment provided under this Section.

## 3.04 PAINTING

A. Prior to Final Acceptance of the Work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

**END OF SECTION**

## SECTION 46 76 42
## SCREW CONVEYORS

### PART 1 – GENERAL

### 1.01 REQUIREMENTS

A. The Contractor shall furnish, install, test and place in satisfactory operation screw conveyor systems, including conveyors, packaged control panels, slide gates, interconnecting chutes, supports, and other ancillary equipment required for a fully functional system. The screw conveyor systems shall transport mechanically dewatered water pollution control plant (i.e., wastewater treatment plant) sludge from the feed points to the final discharge points shown on the Drawings and as described herein.

B. The screw conveyor systems shall be provided by a single manufacturer, complete with all necessary components, drives, motors, instrumentation, controls, ancillary items and supports.

C. The design of the screw conveyor systems shall be based upon the Contract Drawings, these Specifications and the manufacturer's experience with at least five existing systems of similar sizes, capacities and handling material with similar characteristics. These systems shall have been operating for a minimum of 5 years.

D. The Contract Drawings and this Section provide equipment descriptions, minimum requirements and mandatory features of the equipment to be furnished. It is the Manufacturer's responsibility to design and furnish the equipment complete in all details, performance, and reliability meeting the requirements and intent of the Contract Drawings and these Specifications.

E. The equipment shall be furnished complete with all accessories, special tools, spare parts, base attachments, mounting anchor bolts, and other appurtenances as specified herein or as may be required for a satisfactory installation.

F. Conveyors handling dried material with the potential to create combustible dust atmospheres shall be designed to meet requirements of NFPA 68, NFPA 69, and other applicable codes and standards. Conveyor manufacturer shall be responsible for furnishing equipment which meets the requirements of applicable combustible dust codes and standards, and shall engage the services of a qualified combustible dust mitigation specialist to determine the features and provisions for the dried material conveyors specified herein to meet applicable dust mitigation codes and standards.

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## 1.02 CONDITIONS OF SERVICE AND DESIGN PARAMETERS

A. The conveyors shall be capable of operation for the conditions of service described herein.

1. Dewatered Sludge Cake Screw Conveyors

a. The belt filter press dewatered sludge cake characteristics are indeterminate. For the purpose of design, the following conditions of service shall be assumed:

| Parameter | Value |
|---|---|
| Material | Dewatered Municipal Biosolids Sludge Cake |
| Bulk Density (pounds per cubic foot) | 60 |
| Solids Content (% by weight) | 14 to 18 |
| Temperature (°F) | 40 to 100 |

2. Final Product Screw Conveyors

a. The final product solids characteristics are indeterminate. For the purpose of design, the following conditions of service shall be assumed:

| Parameter | Value |
|---|---|
| Material | Thermally Dried Biosolids Product |
| Bulk Density (pounds per cubic foot) | 40 to 45 |
| Solids Content (% by weight) | 90 to 95 |
| Maximum Temperature (°F) | 100 to 120 |

B. The conveyors shall be provided to meet the following design parameters:

| Parameter | Value | | |
|---|---|---|---|
| Conveyor Designation | CON24411, CON23104 | CON26911 | CON26912 |
| Service | Dewatered Cake Feed | Dried Product Transport | Dried Product Truck Loading |
| Volumetric Capacity (cubic feet/hour) | 200 | 55 | 55 |
| Mass Capacity (pounds/hour) | 12,000 | 2,200 | 2,200 |

| Parameter | Value | | |
|---|---|---|---|
| Conveyor Designation | CON24411, CON23104 | CON26911 | CON26912 |
| Minimum Diameter (inches) | 14 | 9 | 9 |
| Nominal Length (See Drawings) | 39’-6” and 42’-6” | 32’-6” | 32’-8” |
| Conveyor Style | Shafted | Shafted | Shafted |
| Drain Opening (inches) | 3 | 3 | 3 |
| Design Bed Loading Factor (percent) | 30 | 20 | 20 |
| Inclination/Slope (degrees) | 12 | 22 | 13 |
| Screw Pitch | Half | Half | Half |
| Maximum Rotating Speed (rpm) | 30 | 30 | 30 |
| Pressure Relief Cover(s) | Yes | Yes | Yes |
| Special Requirements (See following notes) | (1) | (2) | (3) |

(1) Provide conveyor inlet connection to match existing truck loading conveyor discharge flange/gates at Dewatering Building Nos. 1 and 2.
(2) Provide blanked-off intermediate discharge flange for future connection as shown on the Drawings.
(3) Provide spray nozzle connection ports for future dust control oil application as shown on the Drawings.

## 1.03 SUBMITTALS

A. Submit product data and Shop Drawings in accordance with the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions.

B. Structural design calculations and shop drawings of the conveyor support structure signed and sealed by a professional engineer currently licensed in the State of Georgia. Complete calculations shall be provided for all framing members, connections, and concrete anchorage. A summary of column reactions shall be provided to the Engineer to verify the foundation design.

C. Submit design-stage Dust Hazard Analysis(DHA) report for the dried material conveyors. DHA report shall identify combustible dust related hazards and recommend provisions to mitigate the hazards for compliance with referenced codes and standards.

## 1.04 QUALITY ASSURANCE

A. All supports for conveyors shall be provided for the conveyor support framing. The Contractor shall be responsible for coordinating the placement of all supports necessary

to tie the equipment together and shall have the undivided responsibility for the system's structural integrity.

## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. The screw conveyors shall be manufactured by Jim Myers & Sons, Charlotte, NC; or WAM Inc., Lawrenceville, GA.

### 2.02 GENERAL REQUIREMENTS

A. The requirements in this Section shall be considered as minimum requirements. The Contractor or Equipment Supplier shall add such additional features as are necessary for satisfactory operation and functioning of the conveying equipment.

B. Equipment shall conform to Section 46 00 00 – Equipment General Provisions unless modified herein.

C. Equipment provided shall be suitable for a humid and corrosive environment.

D. Structural design shall be in accordance with AISC standards.

E. All materials and construction shall be ASTM A276, Type 304 stainless steel unless otherwise specified. All gaskets shall be neoprene.

F. Stainless steel shall be shop brush blasted to remove heat tint scale and provide a uniform finish.

G. Material thicknesses and dimensions shall conform to the following minimum requirements unless otherwise specified or required for structural considerations:

| Component | Thickness (inches) |
|---|---|
| Trough Bodies | 1/4 |
| Trough Top Flanges | 1/4 |
| Trough Top Covers | 1/8 |
| Trough End Flanges | 1/4 |
| Trough End Plates | 1/2 |
| Trough Discharge Chutes/Spouts | 3/16 |
| Internal Stiffeners | 1/4 |

| Component | Thickness (inches) |
|---|---|
| Internal Shrouds | 3/8 |
| Supports – Welded to Body | 1/2 |
| Supports – Saddle Type | 1/4 |
| Gaskets (Durometer 50) | 1/16 (covers) and 1/8 (all others) |

## 2.03 TROUGHS, COVERS, END PLATES AND CHUTES

A. Conveyor Troughs

1. Conveyor trough bodies shall be “U” type with trough dimensions conforming to the requirements of CEMA Standard 300, with exceptions as noted herein. The conveyor trough bodies shall be rolled to shape with the double formed top flanges formed with, or welded to, the trough body. Trough end flanges, welded to each trough section, shall be provided for joining adjacent sections or connecting trough end plates to the trough sections.

2. Individual trough segment lengths, measured from end flange to end flange shall not exceed the lengths given in the conveyor schedule for each conveyor. Conveyors with lengths greater than the maximum individual trough segment length shall be constructed of two or more sections bolted together at the trough end joining flanges.

3. Each shafted screw conveyor trough shall be equipped with 3-inch-diameter NPT drain nipples located at the drive and tail trough ends and at each intermediate bearing location. The drain nipple(s) shall extend 3 inches below the screw conveyor trough and be supplied with a threaded cap.

4. Where required for dried material handling, conveyors shall meet requirements of NFPA 68, NFPA 69, and other applicable codes and standards for equipment handling combustible dusts. Provide the following features where required to comply with applicable codes and standards.:

   a. Provide provisions to mount temperature sensors for monitoring product and headspace temperature.

   b. Provide internal spray nozzle and external connection for deluge water.

   c. Provide flanged connections for headspace air aspiration (dust draw-off and clean air inlet).

B. Conveyor Covers

1. A sectional stainless steel plate shall cover the entire trough, with the exception of where the inlet chute connections are located. Cover segments at inlet chute connections shall extend, on each side, beyond the inlet chute connection and shall be bolted in place. Each cover section shall be not greater than 6 feet in length. The cover segments shall be arranged so that the trough flange and a trough stiffener provide support to each edge.

2. The covers shall open for maintenance and cleaning purposes. The cover shall be furnished with a toggle-clamp type, or spring clip type, quick release connections on each side of the cover. The quick release connectors shall remain attached to the conveyor trough when the cover is removed.

3. Gaskets shall be installed along each trough cover flange and each stiffener to ensure a drip proof connection and minimize air leakage through the conveyor cover.

4. Pressure relief covers shall be provided at conveyor discharge ends when required by the conveyor schedule and shall expose the full width of the conveyor trough when opened. Pressure relief covers shall be designed to open upon build-up and packing of material at the discharge endpoint. Pressure relief covers shall be supplied with safety limit switches as described elsewhere in this Section.

5. For dried product conveyors, provide a minimum 4-inch diameter flanged clean air inlet at one end of the conveyor, and a minimum 4-inch diameter flanged dusty air draw-off at the opposite end of the conveyor.

6. Where required for dried material handling conveyors to meet requirements of NFPA 68 and NFPA 69, provide provisions for installation of deflagration vents.

C. Conveyor End Plates

1. End plates shall be fabricated from stainless steel plate and shall be bolted and gasketed to the trough end flange. End plates shall be designed to support the drives, bearings and gear reduction assembly.

2. The end plate assembly shall be supported independently of the conveyor troughs. Support points for the drive and tail end assemblies shall be welded to the end plates.

3. Where shafts penetrate the end plates the end plate shall be provided to accommodate the stuffing box.

D. Conveyor Chutes

1. Trough inlet and discharge chutes shall be bolted to the adjoining equipment as shown on the Contract Drawings. Inlet and discharge chutes shall be supplied with reinforced rectangular or circular flanges.

2. Trough inlet chute connection flanges shall be located approximately 3 inches above the top of the conveyor trough. Trough discharge chute connection flanges shall be located approximately 3 inches below the bottom of the conveyor trough.

3. The Equipment Supplier shall furnish connection chutes and transition pieces between the conveyors and related equipment. Chute connections and transition pieces with length greater than 2 feet between flanges shall include at least four handles to facilitate removal of the connection chute. Handles shall be fabricated from 1/2-inch-diameter rod of the same material as the chute, formed and welded to the sides of the chute.

4. Where shown on the Drawings, conveyor equipment supplier shall furnish flexible discharge chutes fabricated from heavy duty rubber resistant to deterioration from contact with dewatered sludge or outdoor exposure.

5. Full-face gaskets shall be provided between each flanged inlet, discharge, connection and transition chute.

## 2.04 CONVEYOR DRIVE TRAIN EQUIPMENT

A. The conveyor drive train equipment shall transmit power to the conveyor drive shaft using a shaft mounted speed reducer directly connected to an electric motor.

B. Drive Shaft Assembly

1. The drive end assembly shall consist of the following components:

a. Drive Shaft

b. Packing Gland/Stuffing Box

c. Hollow Shaft Gear Reducer

d. Bearing and Housing

e. Drive Motor

2. The tail end shaft assembly shall consist of the following components:

a. Tail Shaft

b. Packing Gland/Stuffing Box

c. Bearing and Housing

3. Both drive end and tail end assemblies shall be provided for shafted screw conveyors.

4. Drive shafts and tail shafts on shafted screw conveyors are to be complete with mating connections appropriate for mating the drive shaft to the rotor center tube. The drive and tail shafts shall be of adequate diameter to handle all radial, thrust and torsion loads. The drive and tail end shafts shall be mounted to the shafted rotor by a flanged connection.

5. An adjustable packing gland seal shall be provided where shafts project through the conveyor end plate. Packing glands shall be provided with not less than five packing rings per stuffing box. Packing shall be grease lubricated. Grease fitting(s) shall be provided to lubricate the packing rings.

6. The drive end shaft for cake conveyors shall be provided with both an inside and outside support bearing. Dried product conveyors shall have external end bearings only. The bearings shall be spherical roller bearings mounted in pillow block bearing housings. The inner drive end bearing shall be “free floating” and designed to handle radial loadings. The outer drive end bearing shall be “fixed” and designed to handle radial and thrust loads. The outer drive end bearing shall be mounted outboard of the packing gland/stuffing box assembly with sufficient clearance to permit removal of stuffing box bolts, cover and repack the stuffing box without having to remove the bearing housing or bearing from the housing. The bearing housing shall be fitted with an Alemite grease fitting. Grease feed tubing shall be run from the inner support bearing to a location on the conveyor exterior to facilitate lubrication.

7. The tail end shaft shall be provided with an outside support bearing. The bearing shall be a spherical roller bearing, mounted in a pillow block bearing housing. The outside support bearing shall be outboard of the packing gland/stuffing box assembly with sufficient clearance to permit removal of stuffing box bolts, cover and repack the stuffing box without having to remove the bearing housing or bearing from the housing. The bearing housing shall be fitted with an Alemite grease fitting.

8. Provide intermediate hanger bearings as necessary. Dried product conveyor intermediate hanger bearings shall be of the graphite-based journal type, and shall be non-sparking and self-lubricating.

9. The support bearings shall conform to the standards of ABMA and shall have a minimum L10 life expectancy of 50,000 hours under the design loading condition.

C. Drive Motor

1. Drive motors shall conform to the applicable requirements of Section 26 05 60 – Low-Voltage Electric Motors.

2. Drive motors shall be suitable for continuous severe duty service.

a. Dried product conveyor drive motors shall be rated for a Class II Division 2 environment for equipment processing or handling combustible dusts.

D. Speed Reducer

1. The speed reducer shall be a direct-driven, enclosed shaft mount type unit. The speed reducer shall mount directly on the driven shaft. All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. The reducer will be the standard air-cooled unit with no auxiliary cooling.

2. The speed reducer housing shall be constructed of ductile iron and shall be ribbed for added strength.

3. The speed reducer bearings shall be ball or tapered roller type and provide a 50,000-hour ABMA L10 life at the expected design loading rate. All seals shall be double lip, spring-loaded type and made of nitrile rubber.

4. Speed reducer gears and bearings shall be splash lubricated using petroleum-based oil, containing anti-foam and rust inhibiting additives. Speed reducer installation shall be accomplished by using ductile iron, fully split, twin tapered bushings keyed to the shaft. Reducer removal shall be accomplished by providing jack screw holes in the bushing flanges to mechanically remove the tapered assembly.

5. The speed reducer shall be manufactured to Quality Class 8 per AGMA Standard 6001-C88, minimum. The gear reducer shall be selected for AGMA Class 11 service with a 1.4 service factor based on motor nameplate horsepower.

6. The speed reducer shall be as manufactured by SEW Eurodrive, Inc., Nord Gear Corp., or equal.

## 2.05 CONVEYOR SUPPORTS

A. The conveyor troughs shall be supported using saddle type supports shaped to the profile of the troughs and extending to a common fixed distance below the centerline of the screw. Saddle type supports shall be located not greater than 10 feet center-to-center. Separate support points shall be provided under the drive end and tail end

assemblies. The conveyor trough supports shall be fabricated of the same material as the trough and shall be welded as an integral part of the conveyor assemblies.

B. Stiffeners shall be placed across the top of the trough and fastened on both sides. Stiffeners shall be designed to maintain the trough shape under transport, erection, and loading and shall also act as a face seal for the covers. Stiffeners shall be located so as not to impede the removal of maximum screw lengths as listed herein.

C. Support loadings shall be based on a completely filled trough, weight of the conveyor and the dynamic loading when operating.

D. The Contractor shall coordinate with the Equipment Supplier support locations with the facility structural constraints. Access to other process systems and equipment shall not be restricted by the conveyor supports.

E. Each conveyor shall be field shimmed as required to conform to the manufacturer's installation tolerances.

F. Conveyor support structures shall match concepts as shown on Contract Drawings.

G. Structural steel, support members, hardware, anchors, etc. shall be provided as shown on the Drawings and in accordance with Division 05 – Metals. Support structures shall be constructed of ASTM A36 structural steel shapes. Support members shall be hot dip galvanized coated to a minimum of 3 to 4 mils dry film thickness (DFT) per ASTM A123.

H. Dielectric isolation shall be installed between dissimilar metals which includes between the conveyors and support structures. Fasteners from the support structure to the conveyor shall be stainless steel.

I. Structural design shall be in accordance with the Georgia State Minimum Standard Building Code, as well as requirements on the Structural General Notes Drawing including but not limited to seismic design and windage. In addition, the following requirements will apply:

    1. Live load vertical deflections shall be limited to the span divided by 360.

    2. Horizontal drift shall be limited to the height divided by 360 with a minimum applied lateral load of 10 percent of the total vertical live load in a given braced section.

## 2.06 SHAFTED SCREW ASSEMBLIES

A. Shafts

    1. Screw conveyor shafts shall be fabricated from Schedule 40 (minimum thickness) Type 304 stainless steel pipe with a minimum shaft outside diameter as specified

elsewhere in this specification. The shaft thickness shall be suitable for the expected static and dynamic loadings for each conveyor type specified herein.

2. The allowable shaft deflection between two bearing support points shall not exceed 3/32 inch for a simply supported tube with a uniform loading equal to the mass of the tube and associated flighting or the maximum center-to-center bearing distance as specified elsewhere herein.

3. Each shaft section shall be constructed from a single piece of steel pipe (not fabricated by butt welding sections of pipe). Each shaft end shall be fitted with an appropriate coupling arrangement for affixing the shaft to adjoining shafts, the drive end assembly or the tail end shaft assembly. Couplings shall be Type 304 stainless steel and use stainless steel fasteners.

4. The coupling bolt holes shall be designed to allow for removal of the bolts with the shaft center tube installed in the conveyor without removal of adjoining conveyor sections.

B. Flights

1. Flights shall be fabricated from Type 304 stainless steel with a minimum thickness of 1/4 inch.

2. Flights shall be of sectional construction, pre-cut, with uniform thickness and formed accurately to the design pitch. Radial welds of the sectional flight segments shall be level-welded, full and continuous on both sides of the flight junctions to the shaft.

3. Flights shall extend beyond the end of the screw conveyor shaft to within 3/16 inch of the trough end plate on the drive end and intermediate bearing supports to clear material from inlet and outlet chutes and drain connections.

4. Following fabrication of the screw assembly (flights mounted to shaft) the assembly shall be mounted in a finishing jig and the flight outside diameter trimmed to a true circular diameter about the centerline axis of the shaft tube within +/-0.050 inch.

5. Flighting shall be formed accurately to the pitch required within +/-5/32 inch, with an average deviation of the pitch not exceeding +/-1/8 inch over the length of the conveyor between bearings. Flanged faces shall be machined to +/-0.001 inch perpendicular to the centerline axis of the screw. Screw pitch shall be measured at the outside diameter of the screw flights along four straight lines parallel to the axial centerline of the spiral at 90° offsets and shall not vary more than +/-0.02 times the screw flight outside diameter from the design pitch.

6. The Equipment Manufacturer shall repair or replace the spiral flighting not found in compliance with the previously specified tolerances with new equipment until the spiral flighting meets the dimensional tolerance requirements. All refurbishment and payments necessary for ascertaining the dimensional tolerance of repaired or new replacement equipment shall be borne by the Equipment Manufacturer.

C. Intermediate Bearings

1. The conveyor flighting shall be supported by CEMA Style 226, Type 304 stainless steel hanger bearing brackets with hardened iron bearings (cake conveyors) or graphite based bearings (dried material conveyors), hardened coupling shafts and grease pipe extensions. Intermediate bearings shall be provided on shafted conveyors with a maximum center-to-center separation between bearings not greater than 12 feet. The intermediate bearing assembly shall be designed to allow removal of the bearing assembly without removal of the adjoining rotors, shafts, or bearings.

2. The conveyor flighting for dried product conveyors shall be supported by graphite-based journal bearings. Bearing material shall have minimum 20,000 psi compressive strength, minimum Shore hardness of 40, and minimum density of 2.4 g/cc. Bearing shall be Graphalloy 1017 or equal.

3. The conveyor flights shall cantilever beyond the rotor end on each side of the bearing such that the gap or missing space without blade shall not be greater than 3 inches. The extended flight sections shall be supported from the adjacent torque tubes to accommodate the intermediate bearing support bracket. The bearing shall conform to the standards of the ABMA and shall have a minimum L10 life of 50,000 hours.

4. Intermediate bearing assemblies shall accommodate torsional load, misalignment, and longitudinal movement in two directions due to thermal expansion and differential loadings of the screw conveyor rotors both upstream and downstream due to sludge loading. Intermediate bearings shall be free-floating transmitting thrust loadings to one end of the conveyor where the thrust end fixed bearing is fitted.

5. Seals shall be provided on both sides of the intermediate bearing to prevent sludge contamination of bearings and grease leakage into the conveyed sludge.

6. The intermediate bearing shall be supported by both sides of the conveyor trough using support brackets with bolted connection through the trough walls.

7. Type 304 stainless steel tubing shall be provided to transmit grease from the grease fitting mounted external to the conveyor trough to the intermediate bearing. The bearing housing shall be equipped with an access port allowing grease to

enter the central bearing area and seal assembly. Grease tubing shall be routed to prevent damage to the tubing from the material being conveyed and to prevent clogging or bridging of the conveyed material.

8. The intermediate bearing shall be equipped with a spring-loaded lubricator assembly. The lubricator assembly shall be located above each intermediate bearing location. The lubricator assembly reservoir shall be equipped with a metal base complete with base coupling, piston with O-rings, compression springs, and filling connections.

## 2.07 SAFETY DEVICES AND LIMIT SWITCHES

A. Safety Pull Cords

1. Each screw conveyor shall be furnished with emergency pull cords running on both sides of the conveyor and a safety stop switch in compliance with OSHA standards.

2. Pull cord cabling shall be 3/16-inch O.D. fabricated of internal 3/32-inch 7 x 7 strand galvanized aircraft cable and orange colored nylon outer sheathing. Cabling shall be supported by galvanized steel or chrome-plated eyebolts every 10 feet. Wire clamps shall be stainless steel.

3. For General Purpose Areas, the switch assembly shall be able to handle up to 200 feet of conveyor length. Safety switch shall be housed in a NEMA 4X enclosure (aluminum or stainless steel) and shall have a DPDT micro-switch and stainless steel external hardware. Emergency pull cord and safety switch shall be Conveyor Components Company Model RS-2, or equal.

4. For Hazardous Classified Areas, the switch assembly shall be able to handle up to 200 feet of conveyor length. Safety switch shall be housed in a NEMA 7/9 enclosure (aluminum or stainless steel) and shall have a DPDT micro-switch and stainless steel external hardware. Emergency pull cord and safety switch shall be Conveyor Components Company Model RS-2X, or equal.

B. Zero Speed Switches

1. Provide non-contacting, proximity-type speed switch on screw conveyors to detect zero speed condition. The zero speed switch shall consist of a sensor/pre-amplifier and an amplifier/output unit. For shafted screw conveyors, the switch shall be located on the non-driven end of shafted conveyors.

2. The sensor/pre-amplifier shall utilize magnetic proximity effect to detect equipment rotational speed without physical connection to the rotating equipment. Sensors shall provide output pulses in proportion to rotational speed by detection of the

rotating flights of a shafted screw assembly. The sensor shall operate satisfactorily with air gaps of up to 4 inches. The sensor/pre-amplifier shall be provided complete with mounting flange, threaded body and locknut.

3. The amplifier/output switch unit shall provide two SPDT contacts that operate on detection of an under-speed operating condition. The SPDT contact outputs shall be rated for 5A at 120VAC. The unit shall include an adjustable start-up delay of 0 to 60 seconds to override zero speed alarm during initial acceleration. Units shall operate on 120VAC power provided by the packaged control panel. Provide set point adjustment range of 2 to 3,000 pulses per minute. The amplifier/output switch unit shall be furnished with NEMA 4X stainless steel enclosure.

4. Zero speed detection switches shall be Milltronics MFA-4 with MSP-12 or XPP-5 sensor/pre-amplifier or equal.

C. Pressure Relief Cover Limit Switches

1. Each pressure relief cover shall be furnished with a limit switch for detection of a pressure relief operating condition and initiation of conveyor shutdown. Limit switches shall be of a heavy-duty design as furnished by Square "D" or equal.

D. Deflagration Protection (Conveyors CON26911 and CON26912)

1. Dried product handling conveyors shall be designed to meet the requirements of NFPA 68, NFPA 69, and other applicable codes and standards for equipment processing or handling combustible dusts. Provide deflagration venting, temperature monitoring, spray water systems, sweep air connections, and other design features as required.

2. A rotary valve will be provided as part of the dryer system and will be mounted at the discharge of the dryer cooling conveyor as shown on the Drawings. The rotary valve will be controlled by the dryer System Supplier. Dried product conveyor manufacturer shall provide additional isolation between connecting equipment as required.

## 2.08 ELECTRICAL AND CONTROL REQUIREMENTS

A. Electrical Requirements

| Parameter | Value | | |
|---|---|---|---|
| Conveyor Designation | CON24411, CON23104 | CON26911 | CON26912 |
| **Motors** | | | |
| Rating | 460V, 3-ph, 60 Hz | 460V, 3-ph, 60 Hz | 460V, 3-ph, 60 Hz |
| Horsepower (hp) | 5 | 5 | 5 |
| Speed (rpm) | 1,800 | 1,800 | 1,800 |
| Enclosure | TEFC | Class II, Division 2, Group G rated | Class II, Division 2, Group G rated |
| Insulation | Class F | Class F | Class F |
| Inverter Duty | No | No | No |
| Drive Type | Reversing | Non-reversing | Non-reversing |
| Service Factor | 1.15 | 1.15 | 1.15 |
| **Instrumentation** | | | |
| Space Heater | No | No | No |
| Motor Winding Temperature Switches | No | No | No |
| Separate Cooling Fan | No | No | No |
| Packaged Control Panel | Yes | Yes | Yes |

## 2.09 CONTROL PANEL

A. Provide control panels, electrical components, instrumentation and wiring for a complete, functional system.

B. The equipment manufacturer/supplier shall provide control panels in accordance with Section 46 07 01 – Packaged Control Panels and as shown on the Drawings.

1. One system control panel for Dewatered Cake Feed Conveyor No. 1 (CON24411)

2. One system control panel for Dewatered Cake Feed Conveyor No. 2 (CON23104)

3. One system control panel for Dried Product Transport Conveyor and Dried Product Truck Loading Conveyor (CON26911 & CON26912)

C. Dewatered Cake Feed Conveyor Nos. 1 and 2 (CCP24411 and CCP23104)

1. The manufacturer shall incorporate all necessary devices in each control panel to completely control the conveyor system, including but not limited to conveyor motor(s), gate(s), instrumentation and e-stop.

    a. The control panel shall be responsible for control of the motor starter installed within the panel.

    b. The control panel shall be mounted where shown on the Drawings. All components factory tested as a fully operational component.

    c. The control panel shall operate from a single connection to a 480V, 3-phase power source.

    d. The control panel short circuit rating shall be 65kA RMS Symmetrical at 480VAC.

    e. 120V, 1-phase power to the zero speed monitors for each conveyor shall be derived from the corresponding conveyor control panel.

2. Control Panel Features

    a. Wall-mounted, NEMA 4X, Type 316L stainless steel

    b. Contains equipment for control logic described as follows and motor controllers.

3. Power Supply: 480V, three-phase, 60 Hz. Provide panel with main circuit breaker disconnect, including external operating handle. Provide panel with 120VAC control power transformer and any necessary 24VDC/VAC power supplies.

4. The panel shall have the following front-mounted control devices:

    a. ON-OFF-AUTO (O-O-A) selector switch for conveyor

    b. START-STOP selector switch for conveyor

    c. RUN pilot light for conveyor

    d. FAULT alarm pilot light for conveyor

    e. ZERO SPEED pilot light for conveyor

    f. COVER OPEN pilot light for conveyor

g. E-STOPPED pilot light for conveyor

h. OPEN-CLOSE selector switch for gate

i. OPENED pilot light for gate

j. CLOSED pilot light for gate

k. AVAILABLE pilot light for each gate

l. ALARM SILENCE pushbutton

m. ALARM RESET pushbutton

n. ALARM BEACON

o. ALARM HORN

5. Remote Indication and Alarming

   a. The panel shall have the following dry contacts for remote indication. Alarm contacts shall be normally closed. Status contacts shall be normally open.

      1) RUNNING status for conveyor

      2) FAULT alarm for conveyor

      3) IN AUTO status for conveyor

6. Remote Control

   a. The panel shall have the following commands from dry contacts external to the panel:

      1) RUN command for conveyor

7. System Operation

   a. When the field O-O-A switch is in the ON position, the conveyor shall start or stop based off of the START-STOP selector switch.

   b. When the field O-O-A switch is in the OFF position, the conveyor shall not run.

c. When the field O-O-A switch is in the AUTO position, the control panel shall control the conveyor.

1) Start/Stop: When controlled automatically, the conveyor shall operate in response to the Run Command from the plant PLC (LCP-26).

d. Interlocks: E-STOP pushbutton and COVER OPEN limit switch

D. Dried Product Conveyor System Control Panel (CCP-CON26912)

1. The manufacturer shall incorporate all necessary devices in the control panel to completely control the conveyor system, including but not limited to conveyor motors, gates, instrumentation and e-stop.

a. The control panel shall be responsible for control of the motor starters installed within the panel.

b. The control panel shall be mounted where shown on the Drawings. All components factory tested as a fully operational component.

c. The control panel shall operate from a single connection to a 480V, 3-phase power source.

d. The control panel short circuit rating shall be 65kA RMS Symmetrical at 480VAC.

e. 120V, 1-phase power to the zero speed monitors for each conveyor shall be derived from the control panel.

2. Control Panel Features

a. Wall-mounted, NEMA 4X, Type 316L stainless steel

b. Contains equipment for control logic described as follows and motor controllers.

3. Power Supply: 480V, three-phase, 60 Hz. Provide panel with main circuit breaker disconnect, including external operating handle. Provide panel with 120VAC control power transformer and any necessary 24VDC/VAC power supplies.

4. The panel shall have the following front-mounted control devices:

a. O-O-A selector switch for each conveyor

b. START-STOP selector switch for each conveyor

c. RUN pilot light for each conveyor

d. FAULT alarm pilot light for each conveyor

e. ZERO SPEED pilot light for each conveyor

f. COVER OPEN pilot light for each conveyor

g. E-STOPPED pilot light for each conveyor

h. ALARM SILENCE pushbutton

i. ALARM RESET pushbutton

j. ALARM BEACON

k. ALARM HORN

5. Remote Indication and Alarming

   a. The panel shall have the following dry contacts for remote indication. Alarm contacts shall be normally closed. Status contacts shall be normally open.

      1) RUNNING status for each conveyor

      2) FAULT alarm for each conveyor

      3) IN AUTO status for each conveyor

6. Remote Control

   a. The panel shall have the following commands from dry contacts external to the panel:

      1) RUN command for each conveyor

7. System Operation

   a. When the field O-O-A switch is in the ON position, the associated conveyor shall start or stop based off of the associated START-STOP selector switch.

   b. When the field O-O-A switch is in the OFF position, the associated conveyor shall not run.

c. When the field O-O-A switch is in the AUTO position, the control panel shall control the conveyor system.

1) Start/Stop: When controlled automatically, the conveyor system shall operate in response to the Run Command from the plant PLC (LCP-26).

d. Interlocks: E-STOP pushbutton and COVER OPEN limit switch

## 2.10 SPARE PARTS

A. Conveyor manufacturer shall provide the following spare parts for each size and type furnished.

1. One speed reducer of each size

2. One zero speed switch

3. One safety trip cord switch

4. One set of packing material for each conveyor

5. One intermediate bearing assembly (shafted only)

B. Conveyor manufacturer shall provide any special tools required for servicing and/or maintenance of the screw conveyors.

# PART 3 – EXECUTION

## 3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions. For each series of conveyors, field services shall include the following site visits:

| Service | Number of Trips | Number of Days/Trip |
|---|---|---|
| Installation and Testing | 1 | 2 |
| Startup and Training | 1 | 2 |

## 3.02 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.

## 3.03 FIELD TESTING

A. Preliminary and final field tests shall be performed in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

B. Preliminary Field Tests: Run 2-hour no-load test on each screw conveyor. The test shall consist of the following:

1. Check starting and running amperage for 5 minutes.

2. If units operate vibration free and quietly with normal amperage, test is acceptable.

C. Final Field Test: Run a 16-hour test at plant's highest available load conditions. Each conveyor shall be used in succession during this period. This test may occur either immediately following or totally separate from the Preliminary Field Test. The testing program shall be considered complete when equipment satisfactorily and continuously operates without downtime for maintenance or repair for 16 hours split over two test periods of 8 hours each.

**END OF SECTION**

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**SECTION 46 76 70**

**INDIRECT THERMAL SLUDGE DRYING SYSTEM**

## PART 1 – GENERAL

### 1.01 DEFINITIONS

A. "System": The complete Thermal Dryer System, which shall include all equipment, controls, instrumentation, and all appurtenances required such that a fully functional Thermal Dryer System is realized.

B. "System Supplier": The person, partnership, corporation, association, or affiliation with whom the "Contractor" executes an agreement for the supply of the System and related components and services as described within this Section.

C. Reference Section 00 72 00 – General Conditions for additional definitions.

### 1.02 SCOPE

A. The Thermal Dryer System Supplier, hereinafter referred to as the "System Supplier", shall design, furnish, deliver, supervise component assembly and installation, commission, and performance test all the equipment necessary to provide a complete Thermal Dryer System, hereinafter referred to as the "System", including all ancillary equipment as defined as follows. The System shall be capable of producing a dried product from a partially dewatered wastewater sludge cake at the rates specified herein.

B. The Contractor shall be responsible for the final component assembly and installation of the equipment provided by the System Supplier. The Contractor may, at their option, arrange for the System Supplier to provide services beyond those previously described herein, including final assembly and installation services for the equipment provided under this Section. Utilization of the System Supplier for final assembly and installation shall in no way remove the obligation of the Contactor to deliver to the Owner a fully functional System.

1. Contractor shall also be responsible for completing a Dust Hazard Analysis (DHA) after facility startup as specified herein.

C. It is the intent of this Section to describe the process and major mechanical components comprising the System and establish the minimum quality standards for equipment, materials, construction, and process performance.

D. It is the intent of this Section to obtain a complete and functional System including, but not limited to, anchor bolts, fasteners, interconnecting equipment, and interconnecting ductwork and chutes that are part of the System Supplier's scope as specified herein. Any omission of required equipment from this Section shall not relieve the System Supplier of their responsibility for supply of components and the satisfactory operation of

the System. If an item of equipment, component, appurtenance, accessory, etc. is not specifically described in this Section as being part of the System Supplier's scope, the Contractor shall furnish it as part of their scope of supply.

E. The System Supplier shall furnish a complete instrumentation and control system for the System. The System shall include all materials and documentation required to install, test, and place in operation a complete and operable instrumentation and control system as specified. The System shall include all measuring elements, control devices, signal converters, transmitters, packaged vendor control panels (VCPs), motor control panels (MCPs), digital hardware and software, and communication networks to provide the functions indicated.

F. The System shall be designed for and provided with a dry chemical pellet (carbon with aluminum oxide, magnesium oxide, sodium bicarbonate, and sodium permanganate) odor control system with an associated centrifugal fan.

G. All equipment shall be designed to operate with a natural gas (NG) feed as the fuel source for the thermal drying process.

H. Items to be included in the System shall include, but not be limited to, the following:

1. Equipment for receiving and storage of dewatered cake from the dewatering process and conveyance of dewatered cake from the dewatered cake feed hoppers to the dryer. This system shall include, at a minimum, dewatered cake feed hoppers (with dual screw live bottom and leveling screws), dewatered cake feed pumps, and interconnecting dewatered sludge cake piping.

2. A thermal fluid heating system suitable for the specified fuel feedstock. The thermal fluid heater shall be suitable for the heating of the hot fluid heat transfer medium to be utilized in the System. Thermal fluid recirculation pump, thermal fluid expansion tank, catch tank, interconnecting thermal fluid piping and valves, exhaust stack, flame safety panels, and fuel feed and control equipment shall be included with the thermal fluid heating system.

3. Indirect hot fluid system for screw dryer to produce dried sludge granules such that no ancillary granulation equipment is required.

4. Inclined cooling screw conveyance prior to transport to drive-under truck loading. Final product cooling for reducing final product temperature prior to loading shall not be greater than 30°F above the maximum cooling water (i.e., filtered Final Effluent (FE) Water) temperature specified in Paragraph J of Article 1.05 herein.

5. Off-gas particulate removal and condensing system for removal of moisture from the gas stream and a scrubber system for control of particulates and gaseous emissions in the exhaust gas system.

6. Exhaust fans required for the conveyance of air through the process units, including the condenser fan for pulling hot moisture laden air through the dryer and condenser.

7. Exhaust stack from thermal fluid heating system and foul air ductwork from outlet flange of exhaust fan to odor control system.

8. Explosion venting, explosion prevention, and fire protection and prevention systems as required.

9. Access provisions including platforms, catwalks, ladders, guards/handrails, and stairways to provide access from floor level to the operating equipment.

10. Electrical system components including motors, MCPs, electrical power panels, and variable frequency drives (VFDs).

11. Complete instrumentation and controls package including all control panels, programmable logic controller (PLC), and field instruments required for a complete System.

12. Control interface including human machine interface (HMI) in main control panel and local control stations where required. Equipment items not appearing in the previous list but necessary for the complete System are not eliminated by reason of such omission and shall be furnished by the System Supplier unless specifically noted as being furnished by others.

## 1.03 SUBMITTALS

A. Shop drawings shall be submitted to the Engineer for all equipment furnished under this Section. Submittals shall include the following information:

1. Performance characteristics and descriptive data.

2. Detailed equipment dimensional drawings and setting plans.

3. General lifting, erection, installation, and adjustment instructions and recommendations.

4. Complete information regarding location, type, size, and length of all field welds in accordance with AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination. Special conditions shall be fully explained by notes and details.

5. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

6. Details on materials of construction of all components including applicable ASTM designations.

7. Information on bearing types and bearing life.

8. Gear box design and performance criteria and AGMA service factor.

9. Piping schematics for System Supplier-furnished piping.

10. Motor data sheets indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service rating; rotative speed; motor speed-torque relationship; efficiency and power factor at 1/2, 3/4, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.

11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.

12. Equipment factory coating systems, interior and exterior.

13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.

14. A list of spare parts and special tools to be provided.

15. Any additional information is required to show conformance with the specified equipment requirements.

16. Warranty documentation, including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

B. In addition to the shop drawing submittals previously described herein (Paragraph A of Article 1.03 herein), the System Supplier shall submit the following additional information:

1. A Process Flow Diagram and Heat and Materials Balance for the System.

2. Process and Instrumentation Diagrams for the System showing the various system components proposed; mechanical equipment drives; process valves, piping and ductwork; and process instrumentation. General descriptions of system components (i.e., horsepower, diameter, length, height, volume, capacity, primary materials of construction) shall be shown for the various major system components. Major system components are those identified on the Contract Drawings with a numerical component code.

3. Utility requirements for the System for electrical, NG, cooling water, and quench water.

    a. Electrical utility requirements shall include the amperage required for the System MCP main feeder at 480VAC, 3-phase.

    b. NG requirements shall include flow and pressure upstream of the gas control equipment and be based on a low heating value (LHV) of 920 Btu/SCF when the System is operating at the design evaporation rate.

    c. Cooling water and reclaimed water requirements shall include both pressure and flow requirements at the interface points and be based on a summer water temperature of 80°F.

4. Specifications and equipment data sheets for each of the mechanical and process equipment components for the System to be furnished. Specifications and equipment data sheets shall be in sufficient detail to fully describe the various process components within the System Supplier's scope of supply with regard to materials of construction, capacities, performance, operation, safety features, finishes, dimensions, weights, power requirements, handling and storage requirements, and other information as necessary to establish the standard of quality.

5. Specifications and equipment data sheets for each of the electrical and instrumentation and control system components for the System to be furnished. Specifications and equipment data sheets shall be in sufficient detail to fully describe the various process components within the System Supplier's scope of supply with regard to materials of construction, capacities, performance, operation, safety features, finishes, dimensions, weights, handling and storage requirements, and other information as necessary to establish the standard of quality. Electrical submittals shall include one-line diagrams, point-to-point connection diagrams with cable information, and elementary wiring schematics for all electrical equipment to be furnished by the System Supplier. Refer to the following sections of the Specifications for additional submittal requirements:

    a. Section 23 51 00 – Breechings, Chimneys, and Stacks

    b. Section 26 05 60 – Low-Voltage Electric Motors

    c. Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers

    d. Section 40 06 20 – Process Pipe, Valve, and Gate Schedules

    e. Section 40 66 00 – Network and Communication Equipment

    f. Section 46 07 01 – Packaged Control Panels

6. Plans and sections drawn to scale, including electronic files (Revit 2022 or compatible), of a typical thermal dryer system of the size specified in this Section. Sufficient plans and sections shall be provided to show the proposed equipment components in relation to the whole System, including walkways, ladders, stairs and other access and structural components.

7. Estimated air emissions rates from the proposed System when operating at the full design evaporation rate (7,200 pounds water per hour) when firing on NG. It shall be assumed low NOx burners will be required. Calculations documenting the basis of the estimated emission rates shall be furnished with this submittal item. Estimated air emission rates for the stack gases shall be provided for the following constituents (at a minimum):

    a. Particulates (Total PM, PM10 and PM2.5)

    b. Non-Methane Total Hydrocarbon (NMTHC)

    c. Nitrogen Oxides ($NO_x$) as NO2

    d. Sulfur Oxides ($SO_x$) as SO2

    e. Carbon Monoxide (CO)

C. Operation and Maintenance (O&M) Manuals shall be submitted to the Engineer for equipment furnished under this Section. O&M Manual submittals shall conform to the following requirements:

1. The O&M manuals are to include operations and maintenance instructions, parts listings for component parts with sources of supply indicated, recommended spare parts inventory requirements, lubrication and other routine maintenance schedules, emergency operations instructions, troubleshooting guides and diagnostic tools and instructions, and similar information as required to fully describe the O&M requirements for the System.

2. O&M manuals shall also include equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of materials, original equipment manufacturers' part numbers and manufacturer's catalog information of all equipment components.

3. Each set of instructions shall be bound together in appropriate three-ring binders with a detailed table of contents.

4. Written operation and maintenance instructions shall be required for all equipment items furnished for the Project. The amount of detail shall be commensurate with the complexity of the equipment item.

5. Information not applicable to the specific piece of equipment installed on the Project shall be struck from the submission.

6. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.

7. Extensive pictorial cuts of equipment are required for operator reference in servicing.

8. When written instructions include shop drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

D. Submittal information furnished under these Specifications shall be furnished to the Engineer for review in searchable electronic copy (.pdf) format, exclusive of Paragraph C of Article 1.03 herein. Two hard copy versions of the O&M Manual shall be provided along with the electronic format. Electronic O&M Manual submittals shall be fully indexed and searchable.

## 1.04 SYSTEM INTERFACES

A. The System shall be fed with dewatered cake from existing belt filter presses (BFPs) through a conveyor system (screw conveyors) provided by the Contractor and not included in the System Supplier's scope of supply.

B. The dewatered sludge cake will be delivered to two dewatered cake feed hoppers at the head of the thermal dryer system furnished by the System Supplier. The System Supplier shall provide, under this Section, the process equipment downstream of the conveyor discharge into the dewatered cake feed hoppers. The System Supplier shall provide in the design of the dewatered cake feed hoppers for the structural support of the dewatered cake feed conveyors.

C. No component of the System shall be supported from the pre-engineered metal building roof or walls. The loads from the System shall be transferred to the floor slab only.

1. Some light loads associated with piping 4 inches in diameter and smaller may be supported from the concrete masonry unit portions of the building walls where approved in advance by Engineer.

D. The System Supplier shall design and furnish to the Contractor all components necessary for installation of the electrical systems that are an integral part of the System, including motors, MCPs, VFD, control panels, and field instruments. The Contractor shall

provide all labor to install the System Supplier's furnished electrical and control systems equipment as well as furnish and install all conduit, raceways, wire and cable trays, terminations, pull boxes, disconnect switches, and necessary supports and appurtenances for installation of the electrical and control system.

E. The System Supplier shall coordinate with the Contractor and the manufacturer of the MCPs and VFDs such that a single manufacturer supplies the equipment.

F. The System Supplier shall coordinate with the Contractor size, location, and routing of all power conduits, raceways, cable trays, and other necessary items. Conduits, raceways, wireways, and other appurtenances shall be routed in neat, organized groupings next to structural components when located above the floor slab. The Contractor shall provide grounding and bonding of all equipment and electronic controls.

G. The utility piping systems covered under this Section include, at a minimum: potable water, non-potable water (i.e., filtered FE Water), NG, nitrogen, compressed air, and other miscellaneous small utility piping required for the System.

1. The System Supplier shall design and furnish utility piping systems, including supports, which are an integral part of the System. This includes any piping that is preassembled by the System Supplier, any packaged "in-built" distribution piping that is part of the System, and <u>all</u> nitrogen and compressed air piping associated with the System.

    a. The Contractor shall be responsible for installing all portions of the integral utility piping systems furnished by System Supplier.

    b. This excludes the potable water, non-potable water (i.e., filtered FE Water), and NG piping from the supply points to the interface points of the System's utility piping, which shall be furnished and installed by the Contractor.

H. The Contractor shall be responsible for furnishing and installing the utility piping systems, including supports, up to the interface points of the System's utility piping.

I. The System Supplier shall design and furnish the thermal fluid supply and return piping system (piping, fittings, valves, and supports) for installation by the Contractor.

J. The System Supplier shall design and furnish the dewatered cake pumping piping systems (piping, fittings, valves, and supports) for installation by the Contractor.

K. Piping and related piping system components shall be routed in neat, organized groupings next to structural components.

L. The Contractor shall be responsible for the design and provision of piping and supports (piping systems) not provided by the System Supplier. Piping systems designs by System Supplier are limited to those specified in this Section.

M. The Contractor shall be responsible for coordination of location of utility connections and penetrations with the System Supplier. The Contractor shall coordinate the routing and location of encased and exposed conduit and wiring with the System Supplier.

N. The System digital control system shall interface with the plant control (SCADA) system over an Ethernet TCP/IP local area network data link. The two control systems shall exchange data such as equipment status, flow rates, alarms, etc. The System, however, shall only be controlled from the System digital control system. The System Supplier shall coordinate graphic screen development with the Owner and Engineer.

O. The System Supplier shall attend two coordination meetings (8-hour duration each) to be held remotely via Microsoft Teams with the Engineer, Owner, and Owner's System Programmer to develop SCADA system design and interface requirements for the System digital control system.

P. Some components require assembly on-site. The System Supplier shall provide, at a minimum, installation and assembly supervision assistance to the Contractor during final on-site assembly of these components. To assist with installation, the System Supplier shall provide an installation supervisor as specified herein. Any calendar days exceeding the specified allotment shall be at additional expense of the Contractor.

## 1.05 OPERATING AND DESIGN CONDITIONS

A. The System shall be designed to operate with the following feedstock:

| Parameter | Value |
|---|---|
| Type of Plant | Municipal |
| Type of Sludge | Current feedstock is a BFP-dewatered, unstabilized waste activated sludge (secondary sludge) |
| Dewatered Cake Solids | 14.0% to 18.0% (Typical Range) / 15.4% (Median) |
| Dewatered Cake pH | 6.0 to 8.0 |
| Dewatered Cake Temperature | 60°F to 95°F |

B. The System shall be designed to achieve the following minimum evaporation rate and feed solids loading rate performance requirements:

| Total Evaporation Rate Requirement | |
|---|---|
| Minimum Design Evaporation Rate | 7,200 pounds (water) per hour |
| Maximum Evaporation Rate | 8,500 pounds (water) per hour |

| Feed Solids Loading Requirements | | | |
|---|---|---|---|
| | Value | | |
| Parameter | Low | Typical | High |
| Dewatered Cake Solids (%) | 14.0 | 15.4 | 18.0 |
| Final Product Solids (%) | 92.0 | 92.0 | 92.0 |
| Wet Solids Feed Rate ($lb_{wet}$/hr) | 8,500 | 8,640 | 8,950 |
| Dry Solids Feed Rate ($lb_{dry}$/hr) | 1,190 | 1,330 | 1,610 |
| Final Product Rate ($lb_{dried}$/hr) | 1,300 | 1,440 | 1,750 |

C. Indoor temperature in the Thermal Dryer Room shall range from 50°F to 110°F.

D. Fuel for the dryer thermal fluid heater shall be NG.

E. The System area shall be classified in accordance with NFPA 820-2020 as follows:

1. Thermal Dryer Room (beyond a 10-foot envelope around the main dryer): Unclassified (NFPA 820-2020 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities, Table 6.2(b), Row 1d)

2. Thermal Dryer Room (inside a 10-foot envelope around the main dryer and ancillary equipment handling dry product): Class II, Division 2, Group G (NFPA 820-2020, Table 6.2(b), Row 1c)

3. Within equipment processing combustible particulate solids (e.g., dried product conveyance): NEC Classification Class II, Division 1, Group G (NFPA 820-2020, Table 6.2(b), Row 1b)

F. Explosion prevention measures in accordance with NFPA 68 – Standard on Explosion Protection by Deflagration Venting and NFPA 69 – Standard on Explosion Prevention Systems shall be provided for all System components. Electrical equipment shall be provided in accordance with the applicable electrical classification requirements as described in NFPA 820-2020.

G. Seismic design shall be in accordance with the most current local (Cherokee County, GA) building code.

H. Wind design shall be in accordance with the most current local (Cherokee County, GA) building code.

I. All access provision items, such as access platforms, catwalks, ladders, guards/handrails, and stairways shall be designed in accordance with the most current local (Cherokee County, GA) building code and applicable OSHA standards.

J. The following utilities shall be available to the Thermal Dryer Facility:

| Filtered Final Effluent (FE) Water | |
|---|---|
| Maximum Temperature (°F) | 80 |
| Minimum Pressure at Interface Point (psig) | 60 |
| Maximum Quantity at Interface Point (gpm) | 408 |

| Natural Gas (NG) | |
|---|---|
| Guaranteed LHV (Btu/CF) | TBD (use 920 for planning) |
| Minimum Pressure at Interface Point (psig) | 5 |
| Quantity Available at Interface (SCF/hr) | TBD |
| Heat Available at Interface (Btu/hr) | TBD |

| Electrical Power | |
|---|---|
| Service Conditions | 480V, 60 Hz, 3-phase |
| Feeder Capacity (amps) | TBD |

K. The System design shall be such to minimize the danger of explosions or fires.

1. Dryer shall be equipped with temperature sensors interlocked with NPW spray extinguishing system to flood the dryer during high temperature situations. Water spray to have manual override of automatic system.

2. Systems that cannot meet this requirement must furnish as part of their supply an explosion suppression system.

L. The dried product handling system shall be designed with safety provisions to minimize the danger of explosions and fires.

M. System Supplier to submit complete System start-up from a cold condition including the pre-start safety checks per the procedures in the O&M Manual, and shutdown procedures and time required for each.

## 1.06 SYSTEM PERFORMANCE REQUIREMENTS

A. All performance guarantees specified herewith apply to operation of the System under feedstock conditions as specified in Paragraph A of Article 1.05 herein.

B. The total installed System evaporation rate shall be at least 7,200 pounds of water evaporated per hour. The System shall have an operational turndown capability to at

least 50% of the design evaporation rate and operate continuously at that rate in a stable fashion.

C. Final product moisture content shall be not greater than 8.0% on average (i.e., final product dry solids content shall be not less than 92.0% on average), with any single sample no greater than 10% moisture content (i.e., 90% dry solids content).

D. The final product temperature, following cooling and upon transport to drive-under truck loading, shall not be greater than 30°F above the maximum cooling water (i.e., filtered FE Water) temperature specified in Paragraph J of Article 1.05 herein.

E. The System electrical efficiency shall not exceed 45 KWh per thousand (1,000) pounds of water evaporated when operating at, or above, the design evaporation rate. The electrical energy usage shall be the metered usage incoming to the MCP equipment furnished by the System Supplier under this Section which shall include electrical energy required to run all equipment covered under this Section.

F. The System thermal efficiency shall not exceed 1,500 Btu/lb (water) based on the guaranteed LHV of NG when operating at, or above, the design evaporation rate. The thermal efficiency calculation shall include only heat energy for combustion provided to the thermal fluid heater and shall not include heat energy required for the odor control system or electric energy consumed by the System. Supplemental heating, or pre-heating, of the feedstock dewatered cake or the drying equipment by electrical energy shall not be permitted.

## 1.07 SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of applicable specifications, codes, and standards of the following organizations and entities. Reference Section 01 42 00 – References for full name of organization or entity associated with each of the below acronyms or abbreviations. Unless specifically indicated herein, specifications, codes, and standards by the following organizations and entities refer to the most current issue available at the time of Bid:

1. AGMA
2. AISC Steel Construction Manual
3. ANSI
4. ASHRAE
5. ASME
6. ASTM
7. AWS

8. CEMA

9. FM

10. IEEE

11. IRI

12. ISA

13. NEC

14. NEMA

15. NFPA

16. OSHA

17. SMACNA

18. UL

19. Local Laws and Ordinances

## 1.08 QUALITY ASSURANCE

A. Equipment Standard of Quality

1. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality.

2. It is the intent to secure high quality materials and equipment in order to facilitate operations and maintenance of the System. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacturing of these particular items.

3. For uniformity, only one manufacturer shall be accepted for each type of product.

4. All equipment shall be designed for the service intended and shall be of rugged construction and of ample strength for all stresses which may occur during fabrication, transportation, installation, and during continuous or intermittent operation; all equipment shall be adequately stayed, braced and anchored. Appearance and safety, as well as utility, shall be given consideration in the design of details.

B. Welding

1. Unless required by code or specified otherwise, all welds shall be of proper size and properly prepared and shall be free of undercuts and inclusions and shall have weld spatter and scale removed.

2. Welding of carbon steel and stainless steel piping and hot gas ductwork shall be in accordance with the latest editions of Section IX of the ASME Boiler and Pressure Vessel Code and ASME/ANSI B31.1 – Code for Pressure Piping.

3. Welding shall be conducted in accordance with ANSI/AWS D1.1 – Structural Welding Code–Steel for carbon steel equipment, and ANSI/AWS D10.4 – Guide for Welding Austenitic Stainless Steel Piping and Tubing for stainless steel equipment.

C. Preparation for Shipment

1. All surfaces of equipment, both interior and exterior, shall be cleaned of grease, chips, dirt and other foreign material.

2. Threaded connections shall be inspected, and irregularities corrected. Threads shall be given a rust preventative coating and shall be protected from damage.

3. Openings shall be closed with substantial covers and waterproof paper, or equivalent, for shipment.

4. Machined surfaces such as flange faces, shafting, etc. shall be coated with a suitable rust preventative material which can be readily removed but which will withstand weather elements in shipment. Exposed machined surfaces shall be protected by wood blocks, wood covers, or other means to prevent damage in transit and handling.

5. Special handling instructions shall be conspicuously placed on all equipment requiring unusual handling or shipping care.

D. Equipment Delivery

1. The Contractor shall be responsible for coordinating delivery of all material to the jobsite with the System Supplier. Equipment shall be shipped in sections which are as large as practical to minimize field assembly.

    a. The Contractor must schedule delivery of the System so it arrives at the Project Site no later than 45 calendar days after the System Supplier has notified the Contractor that the System is ready to ship.

2. System Supplier shall clearly identify all contents of all boxes, crates, and packages.

3. The Contractor is responsible for off-loading and proper storage of equipment.

    a. The equipment that comprises the System may only be stored outdoors in its “as-shipped” packaging for a maximum duration of 14 calendar days after delivery to the Project Site. After this 14-day period, the Contractor shall have either installed the delivered equipment in a climate-controlled environment and protected it from weather or properly stored and protected the delivered equipment in accordance with the requirements of Section 01 66 00 – Product Storage and Protection Requirements. Note that specific individual components of the System may require additional storage and/or protection within that 14-day period as directed and required by System Supplier.

4. Each item, or part of an item shipped separately, shall be identified with a weatherproof tag showing the item number.

E. Identification

1. System Supplier shall identify each unit of equipment with equipment item numbers.

2. A permanently attached corrosion resistant tag or nameplate, affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer’s name or trademark and such other information as the manufacturer may consider necessary, or as specified to complete the identification.

## 1.09 SERVICES OF SYSTEM SUPPLIER’S REPRESENTATIVE

A. The services of a qualified System Supplier's technical representative shall be provided. The System Supplier’s representative shall adequately supervise the installation and conduct testing of all equipment, components, and accessories furnished under this Section. The System Supplier's technical representative shall instruct the operating personnel in all System maintenance and operation procedures.

B. The services of the System Supplier’s representative(s) shall be, at a minimum, as follows:

1. Installation Supervisor to guide Contractor through installation. The Contractor may schedule additional supervision at the Contractor’s cost.

2. Once installation is complete, the System shall be subjected to field testing and performance testing by the Contractor and System Supplier as outlined in PART 3 of this Section. Reasonable access shall be provided for the Owner's operating personnel to accompany and observe all field and performance testing operations.

3. Any additional time required to achieve successful installation and operation shall be at no additional expense to the Owner. The System Supplier’s representatives

shall sign in and out at the office of the Owner's/Engineer's resident project representative on each day he is at the Project site.

4. The System Supplier shall provide the following training for the Owner's personnel:

   a. Following completion of the Integrated System Tests (Article 3.06), provide up to 40 total hours of onsite training (2 hours of classroom instruction and 8 hours of hands-on instruction = 10 hours, held four times). The training shall include training on all components of the System, including all auxiliary systems (thermal fluid heating system, off-gas particulate removal and condensing system, compressed air system, conveyance systems, truck loading systems, etc.). The training shall include instructions on start-up and shutdown, normal operating procedures, safety precautions, emergency conditions and procedures, maintenance procedures and schedules, and operation and usage of the System digital control system.

   b. Following completion of training sessions "(a)" previously listed herein, provide up to 24 total hours of onsite training (2 hours of classroom instruction and 8 hours of hands-on instruction = 10 hours, held two times, plus 4 additional hours) on the use of control system software and hardware. The training shall include configuring, documenting, using and maintaining control panels, PLC, and HMI software. The training shall include testing, troubleshooting, and replacement of modules and diagnostics, and use of special tools needed to maintain the System digital control system.

   c. Within 3 to 6 months after training sessions "(a)" and "(b)" previously listed herein are completed, provide up to 24 total hours of onsite training (TBD hours of classroom instruction and TBD hours of hands-on instruction). The follow-up training shall include items previously specified in Items 4.a. and 4.b.

   d. All training specified herein shall take place at the Owner's designated location.

   e. The approved O&M Manual shall be used during all training sessions.

5. The previously listed training durations shall include training on the dewatered cake feed pumps, thermal fluid heater system (heater, recirculation pump, expansion tank, etc.), compressed air system, and inert gas purge system by a qualified O&M training specialist/instructor that is factory-certified and approved by the vendor/manufacturer of each of those equipment items. Training on the overall System and other System components than those previously listed may be performed by the System Supplier themselves.

## 1.10 LUBRICANTS

A. The System Supplier shall obtain from the manufacturers and submit to the Engineer a list of standard lubricants that may be used for each type of lubricant required for the System. The System Supplier shall utilize this list in preparing the comprehensive lubrication schedule. A 1-year supply of lubricant shall be provided by the System Supplier.

## 1.11 CONTROL SYSTEM PERFORMANCE

A. The control system shall be designed to minimize operator requirements and movement in control of the thermal drying equipment. A centralized control location is required from which the entire System can be started, stopped and operated under normal conditions.

B. The control system shall be a PLC-based system utilizing an operator interface terminal (OIT) for input to System operation.

C. From the OIT, the operator shall be able to initiate start and stop sequences for the System. The operator shall also be able to adjust key System parameters that may include, but are not limited to, temperature and speed.

D. Local control capability (HAND operation) shall be provided in the MCP equipment for operation of individual pieces of equipment as may be required for maintenance or testing. All motors shall be capable of software-guided operation through a HAND-OFF-AUTO (H-O-A) selector “button” on the OIT. The dewatered cake feed system equipment shall be capable of operation through a H-O-A selector switch at a local control station or panel mounted near the respective item of equipment as shown on the Drawings; however, this functionality for the dewatered cake feed system equipment shall be governed by interlocks in the PLC control logic, not directly hardwired to the equipment motor starters.

E. The control system shall be complete and inclusive of all items required for the System.

## 1.12 WARRANTY

A. The System Supplier shall guarantee in writing the equipment furnished under this Section against defects in workmanship and material for a period of 24 months from Substantial Completion and subsequent acceptance for beneficial operational use of the System by the Owner.

B. All costs for labor and replacement parts required to repair the unit, due to equipment malfunction, during the guarantee period shall be considered to have been included in the scope letter (i.e., proposal or quotation) price for this System.

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. The System shall be complete with all required and necessary supports, equipment, access provisions, safety guards, soundproofing, thermal insulation, controls and instrumentation, control panels, MCPs, sensors, interconnecting piping and ducting, and valves required for an operable System as specified herein.

B. All anchor bolts for anchoring equipment components and their accessories to their concrete base shall be Type 316 stainless steel. The System Supplier shall furnish anchor bolts. The Contractor shall be responsible for installation of the anchor bolts.

C. Materials and details of constructions shall be System Supplier's standard for service conditions and performance requirements specified unless noted otherwise in this Section.

D. Unless otherwise specified, all bearings shall be designed with an ABMA L10 life of at least 100,000 hours.

1. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor, walkway, or platform elevations.

E. Sampling ports, permanently mounted, shall be provided as required for sampling solid and air streams within the process units. The sampling ports shall be arranged in a manner that allows safe sample collection and minimizes material leakage or spillage during sampling.

F. Access ports shall be provided at convenient locations to allow removal of solid objects trapped within the process units. The ports shall be adequately sized and shall be equipped with removable bolted and gasketed doors.

G. The System Supplier shall supply all motors and drive components for this equipment. Motors shall be suitable for continuous operation and shall be of sufficient horsepower, exclusive of the service factor, to operate the equipment over its full operating range, including start-up loads, without overloading. Motor lubrication may be either grease or oil type.

H. All parts of the equipment furnished shall be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications. Manufactured items shall be new and shall be the products of reputable manufacturers specializing in the manufacture of such products.

I. All parts of duplicate equipment shall be interchangeable without modification. The manufacturer's design shall accommodate all the requirements of these Specifications.

J. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc. shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

K. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

L. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, IEEE, NEMA, and other generally accepted applicable standards.

M. All rotating shafts, couplings, or other moving pieces of equipment, excluding the low speed rotating parts for the screw dryer auger, shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

N. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting without damage or undue stress exerted on its components.

O. All machinery and equipment shall be safeguarded in accordance with the safety codes of the United States of America and the state of Georgia.

## 2.02 ACCEPTABLE SYSTEM SUPPLIERS

A. The System shall be:

1. Bio-Scru screw dryer by BCR Environmental in accordance with the scope letter (i.e., proposal or quotation) included as a supplement at the end of this Section

2. NO SUBSTITUTIONS

## 2.03 SCREW DRYER

A. The screw dryer shall be designed to operate with an oxygen-deficient atmosphere.

B. The screw dryer shall consist of two parallel, hollow-flight auger units and a jacketed enclosure. The auger shall be 48 inches in diameter at a minimum.

C. Total heat exchange area shall be not less than required to meet the evaporation loading requirement specified. The screw dryer shall be heated with thermal fluid as described in this Section.

D. The screw dryer auger shall be subjected to Finite Element Analysis (FEA) Fatigue stress assessment. The objective of this analysis is to confirm design through the FEA

method and show that the augers will conform to the design and fatigue specifications for a 40-year service life as per ASME best practices.

E. The screw dryer shall be designed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1. Each component of the dryer unit containing thermal fluid under pressure, such as housing jacket, & auger, shall have an ASME code stamp.

2. Materials of Construction (Heated): Carbon steel.

F. The screw dryer shall be skid-mounted on a single base/frame constructed of A36 carbon steel to provide support for the shaft bearings, drive assembly and any ancillary equipment, piping, instrumentation, and VCPs.

1. The base/frame shall be supported by legs constructed of A36 carbon steel provided by the System Supplier.

2. The screw dryer shall include an operator access platform and stairs as required to access dryer equipment features at an elevated working surface located on a single long side of the dryer. See Article 2.21 for access platforms, walks and stairway requirements.

G. The screw dryer shall include the following features at a minimum:

1. Reversible auger to enhance mixing and heat transfer.

2. The augers units shall be equipped with tabs to promote local solids mixing and heat transfer.

3. Independent-driven augers with absolute position encoders and controls which permit relative speed control and close approach of flights to facilitate solids mixing and surface cleaning.

4. Independent-driven augers also allow for Pause or “Rock mode” up to 30 minutes, without feed and without discharging material, to allow operators to remove or replace storage containers (trailers, bins, Super-Saks, etc.) if applicable.

5. Dryer system shall include a discharge screw conveyor and an inclined cooling conveyor as specified herein.

H. Safety Requirements: To prevent deflagrations and emissions and in conformance with the System Supplier’s Safety Management Plan:

1. The screw dryer shall include remotely actuated water sprays and controls to quench temperatures for deluge.

2. The screw dryer shall include a continuous nitrogen purge and controls as required to generate and maintain an inert (non-oxidizing) atmosphere within the screw dryer.

3. Per the requirements of NFPA 68, Chapter 7 – Deflagration Prevention by Oxidant Concentration Reduction, the screw dryer shall include a sensor to monitor oxygen concentration inside the screw dryer housing.

4. The screw dryer housing shall have sufficient void space above the operating level of wet/dry sludge to allow for removal of vapors at a superficial velocity the lesser of 1.5 meter/second or 20% of the estimated entrainment velocity to minimize dust entrainment and the associated hazards. The System Supplier shall submit calculations with the Safety Management Plan to the Engineer as part of the submittals.

5. The screw dryer shall be designed as a closed, sealed system to minimize air leakage into the screw dryer and shall operate at a slight negative pressure to prevent emission of odors.

6. The screw dryer enclosure shall have a smooth inner surface and external jacket integrally welded to the enclosure wall.

    a. The lower trough of the enclosure shall be configured to allow intermeshing of the auger and a nominal clearance of 1/2 inch or less between the augers and enclosure.

    b. End cover plates shall include stuffing boxes to provide shaft seals and permit removal of the auger/agitator shaft(s).

    c. Stuffing boxes shall include ports for application of lubricant.

7. The screw dryer shall include the following process nozzles:

    a. The dryer chamber shall include at least three top-mounted, flanged inspection ports.

    b. Two end-cover-mounted flanged access ports.

    c. One 12-inch-diameter flanged round nozzle, Class 300, on one end-cover access port for cake feed.

    d. One top-mounted flanged rectangular nozzle at the feed end for the vapor vent.

    e. One bottom-mounted flanged rectangular nozzle opposite the feed end, for dried product.

f. Multiple thermocouple nozzles located along the length of the dryer, top and bottom, to monitor solids and vapor temperature for process control and compliance verification. The solids temperature monitoring shall be provided via redundant sensors.

8. Prior to insulation, the dryer housing shall be primed with one coat of high temperature paint.

9. The dryer housing shall be insulated and cladded with stainless steel sheet metal to maintain the outer surface temperature below 125°F.

## 2.04 SCREW DRYER AUGERS

A. Two shaft-mounted, heated, intermeshed and counter-rotating augers fabricated with hollow cavities and baffling to permit flow of heat transfer fluid.

B. One end of each shaft shall be hollow to permit the passage of thermal fluid into and out of the auger.

1. Each shaft shall be equipped with a dual-port, rotary union joint, which shall be ELSJA by Kadant Inc. or approved equal.

2. The fixed/rotary seal design shall be spring loaded to maintain seal pressure, and the seal ring shall be carbon impregnated with antimony with front and rear carbon guides.

3. The shaft shall be supported by a precision split graphite bearing.

C. One end of each shaft shall be solid to permit attachment of a gear reducer and a motor.

1. The motor shall be rated for inverter duty.

2. The gear reducer shall be by Dodge or approved equal and shall include an absolute-position encoder to monitor shaft rotational position.

3. The shaft shall be supported with lubricated spherical roller bearing.

## 2.05 DEWATERED CAKE FEED HOPPERS

A. Two dewatered cake feed hoppers shall be provided for the thermal dryer system to receive and store BFP-dewatered sludge cake. The dewatered cake feed hoppers shall each have two leveling screws, a dual screw live bottom, and a minimum usable storage volume of 30 cubic yards.

B. The dewatered cake feed hopper shall be fabricated from Type 304 stainless steel and shall be a minimum of 1/4-inch thick. Hopper walls shall be reinforced as needed with external welded Type 304 stainless steel stiffeners. The hopper structural support frame and structural bracing shall be fabricated from galvanized steel.

C. The dewatered cake feed hopper structural system shall be designed by a Professional Engineer currently licensed to practice in the state of Georgia. Design calculations for the hopper structural system shall be furnished with the submittal package.

D. The dewatered cake feed hopper shall be rectangular in plan view. The side slope shall be at an angle of approximately 65° from horizontal to prevent accumulation of dewatered cake on the hopper sides when the hopper is emptied.

    1. The maximum sidewall height of the hopper shall not exceed 11.33 feet overall height above the finished floor to allow feed from the dewatering conveyors. The final dimensions shall be determined following submission of shop drawings.

E. The hopper shall be elevated off the floor sufficiently to allow for the mounting of the associated dewatered cake feed pump below the hopper discharge as shown on the Drawings. The live bottom shall be furnished with a rectangular flange that shall provide for connection of the live bottom with the associated dewatered cake feed pumping equipment. An electrically actuated knife gate valve shall be provided between the discharge of the hopper discharge screw conveyor and the associated dewatered cake feed pump for isolation.

F. The dewatered cake feed hopper shall include two reversible leveling screws furnished complete with 480VAC, 60Hz, 3-phase, inverter duty, totally enclosed fan cooled (TEFC) electric motors, Nord screw conveyor packages (SCPs) for power transmission, and rotary shaft seals.

G. The dewatered cake feed hopper shall include a 12-inch-diameter (minimum) dual-screw live bottom which shall direct dewatered cake contained in the hopper to the associated dewatered cake feed pump. The live bottom shall consist of pitched screws mounted inside a flared trough body and shall be equipped with an AGMA Class II direct drive reducer and a 480VAC, 60Hz, 3-phase, TEFC electric motor. OSHA-required guards and safety equipment shall be furnished for the live bottom.

    1. Each screw shall be separately driven with a geared reducer/motor unit. Each motor shall be inverter grade and controlled by a VFD.

    2. Shaft seals through hopper housing shall be pneumatic type.

H. The dewatered cake feed hopper live bottom shall be equipped with zero-speed switches to detect motion of the live bottom screws and detect if the unit has stopped rotating while the motor remains in operation. The zero-speed switches shall be mounted in accordance with the manufacturer’s recommendations to properly detect and report motion in the live bottom.

I. Flanged bearings and packed stuffing boxes shall be utilized for the connection between the drive motor and the driven shafts in the live bottom.

J. The dewatered cake feed hopper shall be enclosed (covered) and be provided with flanged connections to receive feed from the dewatered cake conveyor discharge chutes, ventilation connection (foul air collection duct) with blind flange, pressure equalization vent, flanged mounting connection for level sensor, and a top-mounted 24-inch x 24-inch hinged access door. The final location and dimensions of all connections shall be determined following submission of shop drawings.

K. The System Supplier shall furnish a VEGAPULS 31 radar level sensor by Vega to be mounted on the dewatered cake feed hopper cover.

1. Level in the dewatered cake feed hopper shall also be measured (via a weight-to-level calculation) using a RL1600 Series Mild Steel Weigh Module system by Rice Lake that is furnished and designed by the System Supplier. Each system shall consist of four RL75016 double-ended shear beam load cells, four RL1600 mild steel compression mounts, one NEMA Type 4X stainless steel junction box, and appropriate lengths of interconnecting load cell cables. One load cell and compression mount shall be furnished for each leg of the hopper. Dewatered cake feed hopper shall also be furnished with one 480/482 Legend Series Digital Weight Indicator by Rice Lake to which all four load cells are connected.

L. Compressed air distribution to pneumatic shaft seals shall be via a piping manifold mounted on each hopper. Piping manifold shall include isolation valve, filter, pressure regulator, and pressure gage for each shaft seal.

## 2.06 DEWATERED CAKE FEED PUMPS

A. Two dewatered cake feed pumps shall be provided for the thermal dryer system, one downstream of each dewatered cake feed hopper. The dewatered cake feed pumps shall be NEMO by NETZSCH. NO SUBSTITUTIONS.

B. The dewatered cake feed pump shall be designed to transport sufficient dewatered cake to the Thermal Drying System to ensure operation under the maximum design loading rate across the full range of anticipated dewatered cake solids concentrations as specified in this Section. The dewatered cake feed pump shall be designed for operation under variable speed conditions utilizing a VFD to be furnished with the MCP equipment for the System.

C. The dewatered cake feed pump assembly shall include an open-throat progressing cavity style pump with drive, gear box assembly, coupling, coupling guards, unitary mounting base and other related accessories required to provide a functional pumping system for transporting dewatered cake from the associated dewatered cake feed hopper to the thermal dryer inlet at any point within the range of sludge conditions described in the service conditions portion of this Section with a minimum 20% safety factor.

1. Dewatered cake feed pump shall be provided as “full-service-in-place” (i.e., FSIP), which shall allow access to the internal rotating components for maintenance

without having to remove the connecting piping, entire rotating assembly, gearbox, or electrical connections.

D. The dewatered cake feed pump shall be designed for an operating pressure of 300 psig and shall be provided with discharge flanges rated for 300-lb service, minimum, per ANSI B16.5. If required, based on piping configuration, the pump and associated discharge piping shall be designed for pressures greater than 300 psig.

E. The dewatered cake feed pump drive shall consist of a 480VAC, 60Hz, 3-phase, TEFC inverter duty electric motor operating at a nominal speed of 1,750 rpm. A speed reduction gear shall be provided with the drive assembly which shall be designed to produce an output speed of the pump rotating assembly of not greater than 90 rpm when the motor is operating at full speed (e.g., 60 Hz output from VFD). The gear reduction assembly shall be rated for AGMA Class II service conditions.

F. Torque shall be transmitted from the drive and gear assembly shaft to the pump rotating assembly through two sealed, fully lubricated, universal joints in the dewatered cake feed pump housing. The universal joints shall be designed for a minimum lifecycle of 10,000 operating hours. The primary universal joint cover shall be fabricated from an elastomeric material similar to the stator material. The primary universal joint cover shall be mechanically attached to the rotating assemblies. The secondary, divisible Type 304 stainless steel housing shall encompass the joint and all bolts shall be isolated from the material being pumped.

G. Wearing parts for both universal joints shall be fabricated from L5 and D6 tool steel and shall be replaceable components in the universal joint assembly. The tool steel utilized in the manufacturer of the universal joints shall have a minimum Rockwell Hardness of 62 to 65.

H. The dewatered cake feed pump stator assembly shall be fabricated of a vulcanized synthetic rubber elastomeric (Buna-N or approved equal) material in a steel casing. The stator assembly shall have a minimum Shore Hardness of 67 to 73. The elastomeric material shall extend beyond the steel sleeve ends to prevent the dewatered cake product being pumped from penetrating the outer steel casing and to provide a seal between the stator and the stator housing.

I. The dewatered cake feed pump rotor assembly shall be fabricated of high chrome (10% to 13%) D6 tool steel hardened to a Rockwell Hardness of 60 to 62. The rotor assembly shall be ground, polished, and coated to a minimum thickness of 250-micron with a hard, non-porous, material diffused into the base metal material. The coating shall have a minimum Vickers Hardness of 1,250.

J. The main drive shaft shall be fabricated from Type 420 chrome steel. The shaft shall be porous, material diffused into the base metal material. The coating shall have a minimum Vickers Hardness of 1,250. The shaft shall be of a split design to enable disassembly without dismantlement of the bearing frame, coupling and driver. The shaft sealing

system shall consist of a minimum of five rings of packing and one lantern ring enclosed in removable seal housing.

K. The dewatered cake feed pump assembly shall be furnished with a discharge side pipe adaptor capable of receiving a multi-point (four minimum threaded connections) lubricant boundary layer injection stream to reduce operating discharge pressures. The discharge size pipe adaptor shall also include a mounting flange or connection for a discharge pressure gauge. Threaded or flanged plugs shall be provided for all connections on the pipe adaptor. The pipe adaptor shall be suitable for a 300-psig operation pressure and be furnished with appropriately rated flanged connections.

L. The dewatered cake feed pump shall be furnished with an electrically actuated knife gate valve by DeZURIK on the discharge piping of the pump downstream of the discharge side pipe adaptor assembly for isolation. Electric actuator shall be by Rotork, AUMA, or Limitorque. The knife gate valve shall be installed by the Contractor. The knife gate valve shall be equipped with proximity switches to send status (OPEN/CLOSED) to the dewatered cake feed pump VCP.

M. The dewatered cake feed pump shall be furnished with an pressure monitoring and protection system on the discharge side of the dewatered cake feed pump as well as run-dry protection. The pressure monitoring and protection system shall include a sealed flange and bladder diaphragm type isolating pressure ring with glycol filling. The pressure monitoring and protection system shall include a pressure gauge and pressure indicating transmitter for local and remote monitoring of discharge pressure. The pressure indicating transmitter setpoint shall be established as required for equipment protection.

N. The dewatered cake feed pump shall be furnished with a temperature monitoring and protection system to monitor temperature and detect an overtemperature condition in the rotor and stator section of the pump. A temperature indicating transmitter shall be integrally mounted in the stator. The temperature indicating transmitter setpoint shall be established as required for equipment protection.

O. The dewatered cake feed pump shall clearly indicate a fault condition arising from valve position, overpressure, or overtemperature by transmitting the fault condition to a remote PLC controller. The remote PLC controller shall sense discharge isolation valve position, discharge overpressure condition, and stator overtemperature condition and automatically generate an alarm signal to be used to stop pump operations when the discharge valve is closed or an overpressure or overtemperature operating condition is detected.

## 2.07 THERMAL FLUID HEATER

A. A thermal fluid heater shall be furnished to produce sufficient thermal energy to meet the evaporation demands of the System. The thermal fluid heater shall be located in a separate Thermal Fluid Heater Room from the thermal drying processing equipment as shown on the Drawings.

B. The thermal fluid heater shall be Model FT-1200-C by Thermal Process Development.

C. The thermal fluid heater shall be rated for a minimum output capacity of 12,000,000 Btu/hr and shall provide thermal fluid with a maximum thermal fluid temperature and design thermal fluid output temperature as recommended by the System Supplier for the specified sludge type.

D. The thermal fluid heater shall be designed to be fired from NG as a fuel source at a rate sufficient to meet 100% of the System heating requirement.

E. The System Supplier shall be responsible for the design, specification, and supply of the interconnecting piping, valves, and insulation (hot fluid supply and return) between the thermal fluid heater and the drying equipment as well as interconnecting piping on the thermal fluid heater skid.

F. The Contractor shall be responsible for the installation of the thermal fluid supply and return piping systems including insulation. For purposes of estimating interconnecting piping the System Supplier shall estimate for a total of 75 linear feet between the interface of the thermal fluid heater and the thermal dryer (150 linear feet total supply and return) system.

G. All components of the thermal fluid heating system shall be coated with a high-temperature paint rated for at least 850°F, Flame Control 850 Series, per System Supplier's standard specifications or equivalent.

H. The thermal fluid heater shall be a vertical helical coil type heater of a forced circulation design. The coil shall be designed and stamped according to the requirements specified under ASME Section VIII – Pressure Vessel Code for 650°F at 200-psig operations. The thermal fluid inlet and outlet connections shall be ANSI 300-lb flanged and shall be fitted with thermowells for sensors to monitor the thermal fluid heater inlet and outlet temperatures.

I. The thermal fluid heater shell shall be externally insulated (insulation type and thickness per heater manufacturer's standards and recommendations) with quilted on expanded metal and covered with an embossed aluminum outer cover to prevent heat loss radiation, accidental injuries due to high surface temperature, and overheating of the working environment. Surface temperature shall be less than 125°F when the System is operating at design conditions.

J. The thermal fluid heater lid shall be removable for inspection and cleaning of the thermal fluid heater. The heater lid shall have a high temperature ceramic fiber blanket lining. Refractory use in the thermal fluid heater shall be minimal to prevent excess heat radiation on uncontrolled shutdown (e.g., system-wide power failure) which shall minimize degradation of the thermal fluid during operational cycles.

K. The thermal fluid heater shall be furnished with a pressure relief valve connected to a 300-lb flanged valve sized and furnished in accordance with the requirements of ASME Section VII for the thermal fluid liquid utilized.

L. The thermal fluid heater shall be furnished with an approved OSHA ladder and guard/handrail system for personnel access for operations, inspection, and maintenance. The thermal fluid heating system shall be furnished in accordance with OSHA, and other applicable safety codes and requirements

M. The System Suppler shall furnish heat loss calculations through the proposed insulation in order to quantify heat losses during thermal fluid heater operation in order that adequate ventilation rates can be furnished within the Thermal Fluid Heater Room. The System Supplier shall also furnish combustion air requirements for the thermal fluid heaters in order that adequate combustion air can be provided in the Thermal Fluid Heater Room.

N. The thermal fluid heater burner shall be of the forced draft type designed to operate on the fuel sources previously described (i.e., NG). The burner shall have an integral spark ignited NG pilot.

O. The thermal fluid heater burner, fan, motor and fuel train furnished shall comply with the applicable requirements of the nationally recognized testing laboratories (e.g., NFPA, IRI, FM and UL).

P. The thermal fluid heater shall be furnished with a full-modulation control system provided to meet the temperature and heat output requirements across the full range of System operations. The turndown capacity of the thermal fluid heater shall be not less than tenfold (10:1) at neutral chamber pressure. Under full modulation control (AUTO Mode), the thermal fluid heater shall regulate firing rate to maintain a desired thermal fluid temperature. Provision shall be made in the controller to allow for control of the thermal fluid heater in HAND (MANUAL Mode) with provision for a low-fire hold for cold System start-up and ON/OFF mode for low heat demand operations.

Q. The thermal fluid heater burner shall be furnished with a flame safety system utilizing a self-checking UV flame detector.

R. The flame safeguard system shall be a FIREYE E110 Series or approved equal, providing automatic burner sequencing, flame supervision, system status monitoring and indication, system self-diagnostics and troubleshooting. The System shall be provided with alpha-numeric characterized read-outs that display recent combustion faults and alarm conditions.

S. The thermal fluid heating system shall be furnished with an VCP that shall be labeled as meeting the requirements of a nationally recognized testing laboratory (e.g., UL). The

VCP shall provide for the local control and monitoring of the thermal fluid heating system and shall contain, at a minimum, the following fault and failure indication:

1. FAULT – High Thermal Fluid Temperature
2. FAULT – High Flue Gas Temperature
3. FAULT – Low Thermal Fluid Temperature
4. FAULT – Low Thermal Fluid Flow
5. FAULT – Burner Flame Failure

T. The thermal fluid heating system shall contain, at a minimum, the following control devices:

1. Status indicator lights
2. Audible alarm horn
3. Temperature Switch – High Thermal Fluid Temperature (TSH)
4. Temperature Switch(es) – High Flue Gas Temperature (TSH)
5. Temperature Sensors – Hot Fluid Supply (resistance temperature detector (RTD) style TE/TIT)
6. Temperature Sensors – Hot Fluid Return (RTD style TE/TIT)
7. Pressure Relief Valve (ASME Section VIII Rated)
8. Fluid Level Switch – Expansion Tank Level (LSL)
9. Differential Pressure Transmitter – PE/PIT to continuously transmit differential pressure across an orifice plate mounted in the thermal fluid supply (thermal fluid heater outlet).
10. Differential Pressure Switch – To monitor differential pressure across the coil.

U. The thermal fluid burner control system components and VCP shall be furnished in NEMA 4 stainless steel enclosures.

V. The thermal fluid heating system shall be furnished with, at a minimum, the following process safety interlocks:

1. When the High Thermal Fluid Temperature switch (TSH) indicates a high temperature condition, the burner shall be shut down and shall not start until the control system reset button is pushed and the fault condition has cleared.

2. When the High Flue Gas Temperature switch (TSH) indicates a high temperature condition, the burner shall be shut down and shall not start until the control system reset button is pushed and the fault condition has cleared.

3. When the differential pressure switch (thermal fluid flow) indicates flow below 95% of design value, the burner shall be shut down and shall not start until the control system reset button is pushed and the fault condition has cleared.

4. When the Fluid Level Switch (LSL) in the expansion tank indicates insufficient thermal fluid in the System, the burner shall be shut down and shall not start until the control system reset button is pushed and the fault condition has cleared.

W. The System Supplier shall furnish exhaust gas ducting and exhaust stack for the thermal fluid heater system.

## 2.08 THERMAL FLUID RECIRCULATION PUMP

A. One thermal fluid recirculation pumps shall be furnished to provide recirculation of thermal fluid from each thermal fluid heater to the thermal dryer. Suction and discharge isolation valves shall be provided for the thermal fluid recirculation pump, in addition to other functional process-related valves, such that the pump can be independently isolated for maintenance.

B. The thermal fluid recirculation pump shall be a low-pressure centrifugal pump by SiHi, Allweiler, KSB, Dean, Goulds, or Chesterton and shall be specifically designed for pumping thermal fluids under the service conditions required for the System and suitable for operation with thermal fluid temperatures up to 550°F.

C. Thermal fluid pump selection shall be such that the service conditions across the range of operating conditions remain within the preferred operating range of the pump.

D. The thermal fluid recirculation pump shall be furnished with mechanical seals designed for thermal fluid use to ensure long life and maintenance-free operation of the pumping equipment. Seal shall be Type 316 stainless steel/silicon carbide or equivalent.

E. The thermal fluid recirculation pump shall be mounted on a common base plate complete with coupling, coupling guard, and TEFC motor. If the thermal fluid pump requires external cooling due to the anticipated operating conditions, an appropriately sized external cooling system, including any ancillary equipment, shall be furnished with the thermal fluid recirculation pump. Pump base plate shall be leveled, anchored, and grouted with non-shrink grout. Coupling shall be flexible design with minimum torque rating equal to or greater than the peak required operating torque, including startup.

F. The thermal fluid recirculation pump shall be furnished with a pump discharge pressure gauge (0 to 160 psig operating range), pump suction combination pressure/vacuum gauge (-30-inch Hg to 60-psig operating range), and two gauge air bleed valves.

G. The thermal fluid recirculation pump shall be designed to operate under flow and pressure requirements sufficient to circulate the required minimum quantity of thermal fluid required to meet the thermal dryer evaporation requirements. The thermal fluid recirculation pump shall be powered by a 480VAC, 60Hz, 3-phase, TEFC motor operating at a minimum of 1,750 rpm.

H. The thermal fluid pump, where not insulated to protect operating personnel, shall be provided with appropriately designed safety cage and/or guard to protect operating personnel from hot surfaces.

## 2.09 THERMAL FLUID EXPANSION TANK

A. A thermal fluid expansion tank and separate catch tank shall be provided for the thermal fluid heater unit and thermal fluid heating loop. The thermal fluid expansion tank shall be designed to hold, at a minimum, 150% of the System thermal fluid expansion volume based on the total weight of thermal fluid in the System and the maximum differential temperature in the System. The catch tank shall be designed to hold, at a minimum, 50% of the System thermal fluid expansion volume based on the total weight of thermal fluid in the System and the maximum differential temperature in the System. The two tanks together shall result in a total volume of 200% for full containment of overfill.

B. The thermal fluid expansion tank shall be provided complete with all connections, instruments, and valves required for a functional expansion tank system.

C. The thermal fluid expansion tank shall be designed and fabricated for an operating pressure of not less than 50 psig at 550°F and provided with the applicable ASME code stamp for the design conditions.

D. The thermal fluid expansion tank shall be provided with a low level float switch mounted to the bottom of the expansion tank and a stainless steel sight glass level indicator with magnetic flip-tag level indication.

E. The thermal fluid expansion tank shall be provided with an inert gas manifold connection to provide the ability to minimize oxidation of the thermal fluid due to exposure to atmospheric oxygen while in the expansion tank at higher operating temperatures. Inert gas (nitrogen) shall be furnished from the nitrogen system to be furnished by the System Supplier and specified elsewhere in this Section.

F. The thermal expansion tank inert gas system shall be furnished with the following safety and operational components, at a minimum:

1. Two ball type inlet shut-off valves

2. Low pressure switch

3. Pressure regulating valve

4. Pressure gauge

5. Pressure relief valve

## 2.10 THERMAL FLUID

A. Thermal fluid shall be furnished in sufficient quantity to fully charge the thermal fluid heating system including the System volume, piping volume, thermal fluid heater volume, and expansion tank volume.

B. Thermal fluid shall be rated for use in a closed-loop system.

C. Thermal fluid temperature shall not exceed minimum ignition temperature.

D. Thermal fluid shall be Paratherm HE, Paratherm NF, MultiTherm IG-1, or approved equal.

## 2.11 THERMAL FLUID PIPING

A. Thermal fluid piping shall be composed of carbon steel and designed in accordance with ASME/ANSI B31.1 – Code for Pressure Piping.

B. Valves shall be rated for thermal fluid duty and shall include bellows seals having materials of construction as recommended by the System Supplier for the application.

C. Where required to accommodate thermal expansion, flexible hoses shall be Type 304 stainless steel corrugated hoses with external Type 304 stainless steel braided reinforcement.

## 2.12 THERMAL FLUID HEATING SYSTEM EXHAUST STACK

A. Exhaust stack shall be provided in accordance with the requirements of Section 23 51 00 – Breechings, Chimneys, and Stacks.

B. An exhaust stack shall be provided to collect exhaust gases and provide a single point of discharge from the thermal fluid heating system as shown on the Drawings. The thermal fluid heating system exhaust stack shall extend to a height as required to meet the air permit requirements, but not less than 10 feet above the Thermal Dryer Facility roof.

C. The exhaust stack shall be of the self-supporting design and constructed of Type 316L stainless steel. The stack design shall account for thermal expansion, wind, snow and earthquake loads present at the Project site.

D. The exhaust stack shall include two sampling ports 90° apart. The location of the centerline of these ports shall be at least 2.5 feet from the stack exit or other flow disturbances and at least 10 feet downstream of any bends, inlets, constrictions, abatements equipment, straightening vanes, or other flow disturbances. The stack port

locations and construction shall comply with the requirements of 40 CFR, Part 60, Appendix A.

E. Sampling ports shall be a minimum 4-inch-diameter (nominal), standard industrial flanged pipe. Ports shall be installed flush with interior stack wall and shall extend outward from exterior stack wall no less than 3 inches and no more than 8 inches.

F. Stack base shall include provisions to drain condensate and precipitation from within the stack.

## 2.13 COMPRESSED AIR SYSTEM

A. The System shall be provided with a compressed air system consisting of one duty air compressor system. The compressed air system shall be designed to provide sufficient air flow at the required pressure with the System in operation with only a single air compressor in service with a safety factor of not less than 150%. The System Supplier shall be responsible for determining the compressed air system capacity required to meet these criteria. The compressed air system shall be designed for operation with an ambient air temperature of up to 110°F.

B. The air compressor shall be equipped with a 3-micron inlet air filter, separator tank, controller, air-cooled after cooler with moisture separator and sound attenuating enclosure, if applicable. The air compressor shall be furnished with an electric motor operating with 480VAC, 60Hz, 3-phase power service. A small horsepower motor shall be provided for the cooling fan and lubrication pump and be suitable for operation with 480VAC, 60Hz, 3-phase power service.

C. The air receiver tanks shall be provided with an ASME rated pressure relief valve for each receiver tank that is sized to pass twice the air compressor rated output. The receiver tanks shall be provided with a pressure gauge and automatic condensate drain valve with manual bypass and other fittings as required for proper operation of the receiver tanks.

D. The air receiver tanks shall be vertical construction, fabricated to ASME Section VIII, Division 1, rated for 200-psig pressure. Air receiver tanks' capacity shall be sufficient to maintain design pressure in the System without excessive cycling of the air compressor beyond the compressor manufacturer's recommended frequency. Minimum capacity of dry air receiver tank for air compressor shall be 120 gallons, and minimum capacity of receiver tank for nitrogen generator shall be 80 gallons.

E. The common gas drying system to be installed between the wet gas receiver tank and the dry gas receiver tank shall be of the heatless regenerative type capable of providing moisture-free (-40°F dewpoint) air for instrument and pneumatic service. The gas drying system shall consist of an 80-gallon wet compressed air receiver tank and a dual tower-type heatless desiccant-based dryer package. The gas drying system shall include an inlet coalescing filter for removal of liquid, fluid, and particulate material sized 0.01 micron or larger upstream of the desiccant drying system. Dry compressed air

downstream of the desiccant drying system shall be discharged through a 1.0-micron filter to remove particulate material from the desiccant dust.

F. The air compressor system shall be provided in a NEMA 12 acoustic enclosure to provide a sound power level rating of no more than 85 dBa within 5 feet of any direction of the unit. The enclosure shall have removable access panel and shall be designed for complete access to all unit components. Entire enclosure shall be designed to be removable for maintenance purposes.

## 2.14 PROCESS GAS DUCTWORK

A. Ductwork and plenums, unless specified otherwise, shall conform to the more stringent recommendations of the ASHRAE Handbook, SMACNA Round Industrial Duct Construction Standards, SMACNA Rectangular Industrial Duct Construction Standards, and SMACNA Accepted Industry Practice for Industrial Duct Construction, as applicable.

B. All ductwork shall be Type 304 stainless steel. The type, pressure rating, and location of this ductwork shall be provided as required to meet process demands but shall not be less than Class 4 conforming to SMACNA Round Industrial Duct Construction Standards.

C. Unless otherwise specified, duct supports shall be fabricated of galvanized carbon steel. Dissimilar metal isolation shall be furnished and installed at connections between different metals.

D. Ductwork shall be reinforced to prevent sagging, flexing and drumming. Ductwork pressure class shall be for a minimum of -30 inches of water gauge, or greater dependent upon operating conditions. Ductwork shall be sealed to Class A sealing requirements.

E. Sheet metal ducts shall meet the construction requirements recommended by SMACNA and ASHRAE. In addition, rectangular duct section surfaces with areas exceeding 4 square feet shall be cross-broken on both diagonals unless the duct perimeter is beaded at 18-inch or closer spacing. Ducts shall be so constructed, supported and braced to prevent vibration and shall be quiet in operation.

F. Duct curves, bends, offsets, transitions and transformation pieces shall be gradual, to minimize air turbulence. In general, duct transformations changing air velocity shall be designed for minimum loss in total pressure.

G. The center line radius of curved elbows shall be at least 1.5 times the duct dimension parallel to the radius.

H. Instrument test holes shall be provided in the ducts and plenums at appropriate locations for the insertion of 3/4-inch pitot tubes and similar air measuring instruments. Such openings shall be equipped with removable, tight-fitting caps or covers suitable for the intended service.

I. Flexible duct connections and expansion joints shall be provided at ducted connections to fans and equipment. Flexible duct connectors shall be 6-inch-wide minimum. The flexible duct connectors shall be resistant to acids, alkalis, chlorides, gases and all chemicals and reaction by-products. All splices shall be vulcanized. All nuts, bolts, and washers shall be stainless steel.

J. Sheet metal rectangular and circular joints and seams shall have continuously welded flange at every inlet and outlet to all equipment, including dampers. The gasket material shall be EPDM. All bolts, nuts, and washers shall be stainless steel. All other joints and seams shall be continuously welded in accordance with AWS D1.6 – Structural Welding Code – Stainless Steel. Every joint shall be smoke tested with the duct pressure at 30 inches of water gauge. All leaks shall be repaired by welding and retested until no smoke is observed.

K. All process gas ducts shall be externally insulated where required to maintain process heating and thermal efficiency, or as required to provide personnel protection against heated surfaces. Ductwork downstream of the condenser shall not be insulated.

## 2.15 EXHAUST FAN

A. A radial blade type centrifugal exhaust fan shall be provided for the System to remove non-condensed gases from the dryer and direct them through the condenser, downstream dry chemical pellet odor control system, and ultimately an exhaust duct. The exhaust fan shall be Compact General Industrial (GI) Size 105 by New York Blower.

B. The exhaust fan shall be provided with parts fabricated from Type 304L stainless steel for all process gas exposed side parts. The exhaust fan shall be provided with flexible connectors at the inlet and outlet flanges.

C. The exhaust fan casing shall be of welded construction and equipped with a clean-out door, ceramic felt shaft seals, drain plug, and mounted on a unitary base for ease of installation. The fan arrangement shall be as required to accommodate the general arrangement of the equipment.

D. The exhaust fan wheels shall be precision balanced prior to assembly and shall be operated across the full range of operating speeds as a fully assembled unit prior to shipment to confirm proper balancing of the assembled system.

E. The exhaust fan shall be sized by the System Supplier and shall be rated for the operating conditions (e.g., flow, temperature, relative humidity, elevation, pressure) required for a fully functional exhaust fan condition.

F. The exhaust fan shall be driven by an adjustable V-belt drive assembly for direct speed control connected to a 480VAC, 60Hz, 3-phase, TEFC electric motor. An OSHA-approved belt guard shall be included with the drive assembly package. The fan motor shall be sufficiently sized to be non-overloading across the entire performance range of the fan.

## 2.16 OFF-GAS PARTICULATE REMOVAL AND CONDENSING SYSTEM

A. The off-gas particulate removal and condensing system shall consist of a sluiced off-gas duct system and a System Supplier-recommended condenser system. One off-gas and particulate removal and condensing system shall be provided for the System. The off-gas particulate removal and condensing system shall have a downstream off-gas temperature for delivery to the dry chemical pellet odor control system of not greater than 104°F.

B. A water sluiced duct shall be provided to convey off-gases from the thermal dryer to the condenser. The duct shall be fabricated from Type 304L stainless steel and shall have a minimum nominal diameter of 24 inches. Water shall be introduced to the duct through spray nozzle assemblies flange mounted to the duct. The mounting flanges shall be Type 304L stainless steel.

C. The spray nozzle assemblies provided shall be of the non-clogging, self-cleaning type design and mounted at either 90° or 60° angles and shall be easily maintainable and replaceable from the exterior of the duct without having to disassemble the duct.

D. The water sluiced duct shall be positively sloped to the condenser such that water introduced through the spray nozzle assemblies shall carry wetted particulate material to the condenser and away from the thermal dryer.

E. A single-stage barometric condenser shall be provided for the thermal dryer to cool dryer exhaust gases to a temperature of not greater than 104°F when exiting the condenser for downstream treatment. The condenser shall receive inlet flows from the water-sluiced ducts and shall be designed to accommodate the flows generated in the sluiced duct or alternative system recommended by System Supplier to meet temperature requirements.

F. Off-gas exiting the water sluiced duct shall flow counter current to a water spray nozzle assembly for condensing evaporated water via condensation and sub-cooling the gas stream. The spray header systems provided for the condenser shall be removable from the exterior of the vessel to provide for field maintenance, cleaning, and replacement. The spray nozzle assemblies shall be of the non-clogging, self-cleaning type design.

G. The condenser shall be fabricated from Type 304L stainless steel and shall be rated for full vacuum service conditions. The condenser shall be equipped with flanged inlet and outlet connections for handling the off-gas stream and flanged connections for the bottom drain, instrument connections, spray nozzle connections. The condenser shall include flanged inspection ports for each spray nozzle. Flanges shall be provided with standard bolt-patterned connections and be rated for 150-lb, or greater service if required, when larger than 2 inches in diameter.

    1. Internal piping shall be Type 304L stainless steel.

2. Spray nozzles shall be Type 316 stainless steel.

H. Condenser shall be sized to meet the outlet temperature performance conditions.

I. The System Supplier shall provide a switch or transmitter for the cooling water flow to the condenser.

1. The flow signal shall be a permissive signal for System startup.

## 2.17 OFF-GAS ODOR CONTROL SYSTEM

A. The System Supplier shall furnish one dry chemical pellet odor control system (i.e., dryer foul (exhaust) air odor filter), including the following:

1. Upstream mist eliminator

2. Canister composed of 1/4-inch-thick polyethylene with fiberglass reinforced plastic lid

a. 17 cu ft of UL-Classified media (multiple layers of Odorcarb Ultra with Media Life Indicator Pellets and Odormix SP)

b. Capable of maximum flow rate of 500 cfm

c. Two media sampling ports

d. Fernco flexible coupling and adjustable aluminum damper on 8-inch-diameter polyethylene inlet

e. Latches composed of stainless steel and rubber

f. Drum Scrubber 500 (DS-500) by Purafil

3. Differential pressure gauge used to determine pressure drop across the canister

4. Aluminum channel skid on which the system components are mounted

B. All equipment that is located within 3 feet of the odor control ductwork, odor control canister, and exhaust fan and is under positive pressure shall be suitable for a Class I, Division 2, Group D location.

C. The System Supplier shall furnish the foul air ductwork from the outlet flange of the exhaust fan to the odor control system for installation by the Contractor. The Contractor shall furnish and install the foul air ductwork from the odor control system to the foul air discharge point.

D. The Contractor shall install the odor control system, including all appurtenances, and shall be responsible for designing and providing supports for the ductwork from the

outlet flange of the exhaust fan to the odor control system (which includes supports for the mist eliminator and differential pressure gauge) and from the odor control system to the foul air discharge point.

## 2.18 DRYER DISCHARGE SCREW CONVEYOR

A. The dryer discharge screw conveyor shall be manufactured by System Supplier.

B. A covered dryer discharge screw conveyor shall be provided for the System to transport dried product from the dryer unit to an inclined cooling screw conveyor. The dryer discharge screw conveyor shall consist of a single shafted auger designed for the mass and volumetric flow rates required based on the thermal dryer loading conditions.

C. The dryer discharge screw conveyor shall contain one inlet connection to the thermal dryer bottom discharge connection. The discharge screw conveyor housing shall be closed and circular design.

D. The dryer discharge screw conveyor tubular housing shall be insulated with removable blankets consisting of 1-inch mineral wool insulation covered with a polyester fabric or equal to maintain the outer surface temperature below 125°F.

E. Conveyor operation shall be linked to dryer operation and startup/shutdown processes and shall be interlocked to prevent any unit from operating if any of the downstream conveyors are not operating. During a System shutdown, the conveyors shall operate for an adjustable time period after the dryer is shut down to ensure that they have been cleared of dried biosolids. Full function of downstream conveyance shall be a permissive for operation of the System.

F. The dryer discharge screw conveyor shall be direct-connected and suspended from the dryer. It shall also be supported on the inclined cooling screw conveyor inlet flange.

G. The dryer discharge screw conveyor housing shall be fabricated of Type 304 stainless steel. The conveyor auger shall be fabricated of carbon steel with solid flights with a minimum material thickness of 0.25 inch.

H. The dryer discharge screw conveyor drive shall consist of an inverter duty 480VAC, 60Hz, 3-phase, TEFC electric motor operating at a nominal speed of 1,750 rpm. The dryer discharge screw conveyor drive shall be sized to start in a fully loaded condition.

I. The dryer discharge screw conveyor shall be designed for operation under variable speed conditions utilizing a VFD to be furnished with the MCP equipment for the System.

J. A speed reduction gear shall be provided with the drive assembly which shall be designed to produce an output speed in the conveyor sufficient for the volumetric transport requirements when operating under design conditions at appropriate bed loading conditions and design safety factors. The gear reduction assembly shall be

suitable for AGMA Class II operation and shall be by Falk, Dodge Corporation Type JSC, or approved equal.

K. The dryer discharge screw conveyor shall be enclosed to avoid being an odor or dust source. Covers shall be fabricated from 1/8-inch-thick (minimum) Type 304 stainless steel. Covers shall be bolted to the conveyor troughs.

L. The dryer discharge screw conveyor shall be equipped with external lubrication points. The lubrication points shall be readily accessible from either the operating floor level, or walkway platform if elevated.

M. The dryer discharge screw conveyor shall be provided with a zero-speed switch for monitoring movement of the conveyor auger screw. The zero-speed switch shall detect if the auger has stopped rotating while the motor remains in operation. The zero-speed switch shall be mounted in accordance with the manufacturer's recommendations to properly detect and report motion in the conveyor.

N. The dryer discharge screw conveyor shall be furnished with OSHA required safety guards and other required safety equipment.

O. Dried material exiting the dryer discharge screw conveyor shall gravity discharge into inclined cooling screw conveyor.

P. The dryer discharge screw conveyor shall be underhung from the screw dryer enclosure. System Supplier shall be entirely responsible for the design of the associated integral structural supports.

## 2.19 INCLINED COOLING SCREW CONVEYOR

A. The inclined cooling screw conveyor shall be manufactured by System Supplier.

B. A covered inclined cooling screw conveyor shall be provided for the thermal dryer to transport dried product from the dryer discharge screw conveyor to the truck loadout conveyor to be provided by others at drive-under truck loading. The inclined cooling screw conveyor shall consist of a single shafted auger designed for the mass and volumetric flow rates required based on the thermal dryer loading conditions.

C. The inclined cooling screw conveyor shall be designed for indirect cooling of the dried product using non-potable water (i.e., FE Water). Cooling may be achieved by either or both:

1. Non-potable water flowing through a jacketed trough. The cooling jacket shall be designed to maintain a jacket velocity of approximately 2.0 feet per second. Cooling water inlet and outlet flanges shall be furnished for the cooling jacket.

2. Non-potable water flowing through a hollow auger. The inclined cooling screw conveyor shall be fabricated of Type 304L stainless steel for all product contact

surfaces. The conveyor auger shall be fabricated with hollow flights with a minimum material thickness of 0.25 inch with a 0.0625-inch allowance for erosion.

a. The shaft shall be hollow to permit the passage of cooling water into and out of the auger and shall be equipped with a dual-port, rotary union.

D. The inclined cooling screw conveyor shall receive material from the thermal dryer and dryer discharge conveyor at a maximum temperature of 300°F. Normal dried product temperature entering the included cooling screw conveyor shall be approximately 240°F.

E. Cooled dried product shall not be greater than 30°F above the maximum cooling water (i.e., filtered FE Water) temperature as specified in Paragraph J of Article 1.05 herein.

F. The inclined cooling screw conveyor drive shall consist of an inverter duty 480VAC, 60Hz, 3-phase, TEFC electric motor operating at a nominal speed of 1,750 rpm. The conveyor drive shall be sized to start in a fully loaded condition.

G. The inclined cooling screw conveyor shall be designed for operation under variable speed conditions utilizing a VFD to be furnished with the MCP equipment for the System.

H. A speed reduction gear shall be provided with the drive assembly which shall be designed to produce an output speed in the conveyor sufficient for the volumetric transport requirements when operating under design conditions at appropriate bed loading conditions and design safety factors. The gear reduction assembly shall be suitable for AGMA Class II operation and shall be by Falk, Dodge Corporation Type JSC, or approved equal.

I. The inclined cooling screw conveyor shall be fully enclosed to avoid being an odor or dust source. Covers shall be fabricated from 1/8-inch-thick (minimum) Type 304 stainless steel. Covers shall be bolted to the conveyor troughs.

J. The inclined cooling screw conveyor shall be equipped with external lubrication points. The lubrication points shall be readily accessible from the operating floor level.

K. A dried product rotary valve after the inclined cooling screw conveyor shall be required to isolate the dried product handling system in the event a deflagration occurs.

L. The inclined cooling screw conveyor shall be provided with a zero-speed switch for monitoring movement of the conveyor auger screw. The zero-speed switch shall detect if the auger has stopped rotating while the motor remains in operation. The zero-speed switch shall be mounted in accordance with the manufacturer’s recommendations to properly detect and report motion in the conveyor.

M. The inclined cooling screw conveyor shall be furnished with OSHA required safety guards and other required safety equipment.

N. A high temperature switch shall be provided in the inclined cooling screw conveyor to monitor product temperature and upon detection of a high temperature condition shall indicate an alarm condition in the System SCADA control system.

O. The inclined cooling conveyor shall include a floor-mounted base at the inlet end and the System Supplier shall provide a vertical, floor-mounted stanchion to support the inclined cooling conveyor at the discharge end. Structural support shall be provided for the conveyance equipment and shall be designed by a currently licensed Professional Engineer in the state of Georgia. Design calculations for the conveyor structural support shall be included in the submittal package.

P. Non-stainless steel portions of the inclined cooling conveyor shall be coated per painting specifications.

## 2.20 ACCESS PLATFORMS, WALKS AND STAIRWAYS

A. Furnish access provisions consisting of access platforms, catwalks, ladders, guards/handrails, stairways, and other necessary items as required to conform to OSHA and the most current local (Cherokee County, GA) building code and other applicable codes and regulations. All access provisions shall be provided as required to allow convenient and unobstructed access to all areas of equipment requiring routine maintenance. This shall include, at a minimum, equipment drives, bearings, instrumentation nozzles, hatches, lubrication points, sampling points, inspection, and access doors.

B. The structural systems for the platforms, walks and stairways shall be designed by a Professional Engineer currently licensed to practice in the state of Georgia. Design calculations for the structural systems shall be furnished with the submittal package.

C. Access to major equipment platforms shall be by stairs or ladders.

D. Structural steel members shall be free standing and shall be supported from the floor slab only. Anchoring structural supports to the building walls, columns, beams, or ceilings shall not be allowed.

E. The platform and stairs shall be pre-manufactured and erected with only bolting or other fasteners at time of erection in the field.

F. The stairs' structure shall be fabricated of steel with bar grating treads/risers and stainless steel locking fasteners and bolted guards/handrails.

G. Provide guards around all areas requiring personnel access. All guards provided shall be two-rail with toe board, extruded aluminum, minimum tensile strength of 38,000 psi and minimum yield strength of 35,000 psi. Rails and posts nominal 1-1/2-inch-diameter. Post spacing maximum 5 feet. Guards shall be by Thompson Fabricating, LLC, Hollaender Manufacturing Company, or approved equal.

H. All metal grating provided shall be aluminum bar type grating, designed for foot traffic, 100 pounds per square foot minimum uniform service load, maximum deflection of 1/4 inch. Bearing bars shall be spaced at 1-3/16 inch center-to-center, banding 3/16 inch minimum.

I. Ladders shall be aluminum or galvanized steel sized for concentrated load of 250 pounds plus 30 percent impact on the rungs. Maximum rung deflection shall be L/360. Rungs shall be non-slip grip surface.

   1. All ladders, regardless of height, shall be equipped with ladder safety systems. Ladder safety systems shall be Miller Vi-Go by Honeywell, DBI-SALA Lad-Saf by 3M, or approved equal.

J. Structural steel members shall be fabricated in accordance with AISC specifications. Rolled plates, shapes, and bars shall be per ASTM A992 – Standard Specification for Structural Steel Shapes and/or ASTM A36 – Standard Specification for Carbon Structural Steel. Structural steel pipe shall be either per ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing or Type E or S, Grade B per ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless. Structural tubing shall be Grade B per ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes. Welding materials shall be per AWS D1.1 – Structural Welding Code–Steel. Surface preparation by abrasive blast, one coat of minimum 2-mil DFT of rust inhibitive primer. Contractor shall field finish per painting specifications.

## 2.21 EXPLOSION PREVENTION SYSTEMS

A. Furnish explosion venting or prevention systems to control deflagration events within the process units of the System. Design and size the systems in accordance with NFPA 68 – Standard on Explosion Protection by Deflagration Venting and NFPA 69 – Standard on Explosion Prevention Systems.

B. Explosion prevention shall be provided by inertization, internal ventilation, and/or venting.

   1. Venting: Explosion venting shall be provided for the thermal dryer headspace. The venting system shall be sized to safely relieve any deflagration pressures that may develop within the thermal dryer.

      a. Ductwork is provided for direct vented deflagration from the System into the atmosphere. The ducting shall be designed to provide minimal obstruction for venting and shall be pressure rated to withstand deflagration pressures. The ducting shall discharge to the exterior of the Thermal Dryer Facility to allow deflagration venting from the building.

b. Pressures developed in the venting system shall not exceed the pressure rating of the protected vessel.

2. Inert Gas Purge System: As per the System Supplier's Safety Management Plan, the System Supplier shall provide an inert gas (nitrogen or equivalent) purge system to purge or blanket the thermal dryer.

a. An inert gas generator (nitrogen generator) shall be designed and furnished by the System Supplier. The inert gas generator shall be furnished and installed in compliance with all applicable codes and regulations.

b. The System Supplier shall furnish materials, etc. as required for backup nitrogen gas storage, which shall be sized for a 6-hour holding capacity, for inert gas purge system redundancy. These materials, etc. for the backup system shall include a distribution manifold with all required valves, regulators, safety relief valves, and flexible hose connectors as well as a safety restraint system for keeping the backup gas storage cylinders anchored to the wall as required by applicable local code(s).

1) The Contractor shall mount the distribution manifold on the wall as directed by the System Supplier.

2) The Owner will furnish the high-pressure compressed nitrogen gas cylinders as required for the backup supply.

c. The System Supplier shall provide all necessary appurtenances, including but not limited to, regulators, valves, gauges, switches, and controls for safe and effective operation of the System.

d. The purge system shall be factory wired and plumbed to the thermal dryer skid to maximum extent possible.

e. The inert gas supply piping between the nitrogen generator, compressed nitrogen receiver, and dryer shall be furnished by the System Supplier.

C. Furnish all necessary pipe fill and discharge connections, isolation valves, vent valves, safety relief valves, pressure gauges, line pressure regulators, and all other items necessary for safe operation of the System.

D. Distribution Piping: The System Supplier shall furnish all nitrogen system distribution piping with all necessary supports and appurtenances sized to deliver gaseous nitrogen from the nitrogen generator to application points.

## 2.22 ANCHOR BOLTS

A. System Supplier shall furnish all anchor bolts required for anchoring equipment components, accessories, and structural steel members to their concrete supports and

foundation. Anchor bolts shall be of Type 316 stainless steel. Anchor bolts shall be properly sized to match loads associated with anchored equipment.

B. System Supplier shall provide Contractor drawings showing arrangement and location of anchor bolts in concrete supports and foundations. System Supplier shall coordinate installation of anchor bolts with Contractor to match the equipment installed. Contractor shall be responsible for installation of anchor bolts and provision of any additional hardware, materials, appurtenances, etc. required to install the anchor bolts.

## 2.23 SOUND PROOFING

A. No process unit shall have a sound pressure rating level in excess of 85 dBa within 5 feet of any direction of the unit. Soundproofing shall be provided for the air compressor and where elsewhere specified or required to attain the maximum sound level specified.

1. This requirement does not apply to the thermal fluid heater fan.

B. Soundproofing by acoustically isolated enclosures, or by thermal insulation, shall be allowed. Each unit shall have removable access panel(s) and shall be designed for complete access to all unit components. The entire enclosure shall be designed to be removable for maintenance purposes.

## 2.24 PAINTING

A. Unless specified otherwise, factory surface prepare, prime, and finish exposed exterior ferrous metal surfaces for all equipment and accessories of the System.

1. Standard Coating: For equipment with surface temperatures below 200°F, a standard coating system shall be provided. Prepare surface to receive coating by abrasive blasting or centrifugal wheel blast. Prime with one coat of minimum 2.5-mil DFT epoxy primer. Finish with one coat of minimum 3-mil DFT polyurethane enamel.

2. Thermal Coating #1: For equipment with surface temperatures between 200°F and 450°F, a thermal coating system shall be provided. Prepare surface to receive coating by abrasive blasting or centrifugal wheel blast. Prime with one coat of minimum 2.5-mil DFT inorganic zinc primer. Finish with two coats of minimum 2-mil DFT silicone acrylic.

3. Thermal Coating #2: For equipment with surface temperatures between 450°F and 700°F, a thermal coating system shall be provided. Prepare surface to receive coating by abrasive blasting or centrifugal wheel blast. Prime with one coat of minimum 2.5-mil DFT inorganic zinc primer. Finish with one coat of minimum 2-mil DFT silicone.

B. Surfaces not requiring painting include non-ferrous and corrosion-resistant alloys such as copper, bronze, Monel, aluminum, chromium plate, and stainless steel.

C. Provide colors for all painted surfaces as selected by the Owner.

## 2.25 THERMAL INSULATION

A. The exterior surface of all hot System components, unless otherwise specified, shall be insulated as required to ensure that skin temperature of any part shall not exceed 125°F. The insulation shall be covered with a minimum 28-gauge-thick stainless steel jacket.

B. The insulation shall be chemically and thermally stable fiberglass with a maximum K factor of 0.90 at 600°F or ENERWRAP by ROXUL INC. having equivalent properties.

## 2.26 ELECTRICAL – GENERAL

A. All electrical appurtenances furnished by the System Supplier shall be suitable for the appropriate area designations and classifications specified in Paragraph E of Article 1.05 of this Section.

B. The System Supplier shall provide MCP equipment (e.g., motor starters, VFDs, breakers) for each driven component in their scope of system supply.

C. The System Supplier shall provide H-O-A selector switches for operation and control of all motors and mechanical equipment located at the MCP. In the HAND position, the equipment shall run. In the OFF position, the equipment shall not run. In the AUTO position, the PLC shall control the equipment. PLC station monitoring shall also be provided in the AUTO switch position.

   1. This requirement does not apply to System components that could potentially be damaged by incorrect operation while the H-O-A selector switch is in HAND position and the PLC is not providing intermediate control.

D. All enclosures shall be rated for the applicable electric service conditions.

## 2.27 MOTORS

A. All motors shall be provided in accordance with Specification Section 26 05 60 – Low-Voltage Electric Motors.

## 2.28 MOTOR CONTROL PANELS

A. Provide complete MCP with all necessary accessories (circuit breakers, motor starters, and VFDs) to control all motors provided under this Section.

B. VFDs for motors rated up to 100 hp shall be integrated in the MCP.

C. The MCP shall be provided in accordance with Section 46 07 01 – Packaged Control Panels.

D. The MCP shall be intelligent and shall be networked with the System Master Control Panel by Ethernet/IP as required.

## 2.29 VARIABLE FREQUENCY DRIVES

A. VFDs for motors rated 100 hp and higher shall be standalone units.

B. Standalone VFDs shall be provided in accordance with Section 26 29 23 – Low-Voltage Variable Frequency Motor Controllers.

## 2.30 GROUNDING AND BONDING

A. All equipment, vessels, piping, and ductwork in System shall be bonded and grounded per NFPA standards. Metal-to-metal bolted connections shall be considered bonded. Contractor shall provide bonding jumpers where required.

## 2.31 INSTRUMENTATION AND CONTROL SYSTEM

A. General

1. The System Supplier shall provide all instrumentation and control system components required to operate the System as a turnkey packaged system that is completely integrated. These instrumentation and control system components shall include PLC control panel(s)/cabinet(s), all programming and integration services, and all required field instrumentation. It is acceptable if the System Supplier subcontracts with others to provide portions of the control system design, installation, and/or testing; however, the System Supplier shall ultimately be responsible for the control system design and performance.

2. Interconnecting cabling and conduit shall be furnished and installed by others.

B. Control System

1. The control system for the System shall be PLC-based.

a. The PLC cabinets shall be furnished complete with all of the power supplies necessary for PLC and I/O operation, including sensing power for two-wire transmitters and contact inputs.

b. Field wiring shall not directly terminate on the I/O cards. The PLC cabinet shall be equipped with terminal strips for this purpose. I/O points shall be individually fused on either the card or the terminal strips.

c. I/O shall be allocated such that I/O for common equipment is segregated among differing I/O cards to aid in continued operation under a module fault operation.

d. The central processing unit (CPU) shall be sized with sufficient capacity such that 60% CPU loading will not be exceeded under normal operating conditions. The CPU shall be fully capable of executing ladder logic, analog signal conversion, PID control, alarm generation, and all other activities associated with the operation of the System.

e. Digitally communicated I/O shall be limited to additional information from VFDs and power monitoring. Digitally communicated I/O includes I/O for networked devices that communicate with the PLC and remote I/O panels but does not include remote I/O. Remote I/O may consist of signals from the dryer, condenser, dryer discharge screw conveyor, and inclined cooling screw conveyor. All other I/O shall be hardwired, including I/O for remote I/O panels.

f. PLCs shall be the Allen-Bradley ControlLogix series.

g. The control system for the System shall include, but not be limited to, the following components:

1) System Master Control Panel with a ControlLogix PLC, managed Ethernet switch, uninterruptible power system (UPS), connections to RIO panels via Ethernet/IP, and connection to HMI via Ethernet/IP. System Master Control Panel shall be free-standing, rated NEMA 12, and constructed of stainless steel. Communication with the plant SCADA system shall be available via Ethernet/IP or Modbus.

2) Remote I/O panels shall be provided as needed. Dryer Remote I/O Panel(s) shall have racks and modules for hardwire I/O, managed Ethernet switch, and UPS. Burner Management Panel(s) shall have racks and modules for hardwired I/O, managed Ethernet switch, UPS, and burner safety equipment. Remote I/O panels shall be rated NEMA 4X and composed of Type 316 stainless steel.

2. All PLCs, HMIs, network equipment, and safety instrumentation shall be connected to a UPS unit.

a. Equipment shown to be powered from another UPS unit or UPS provided by other suppliers or subcontractors shall be considered to have met this requirement.

b. Equipment not connected to a UPS power feed shall contain an integral or stand-alone Puls 24VDC UPS. Contractor shall coordinate sizing for minimum 110% connected load and run time of 30 minutes.

c. External bypass circuitry to allow the UPS to be replaced while the cabinet is supplied by utility power shall be provided.

3. The operator interface to the PLC-based system shall be through an Ignition by Inductive Automation HMI system.

    a. Design of HMI system shall make all data available over Ethernet or Ethernet/IP to allow the Owner's System Programmer to integrate selected portions of the control system into the plant SCADA system (will be separately performed outside of this Contract).

4. Panel-Mounted Operator Interfaces: Where indicated, panel-mounted operator interfaces shall be provided on the process floor and integrally mounted with control system hardware. At System Supplier's discretion and at no additional cost to Owner, these may be Allen-Bradley Panel View Plus 7 OITs or a panel-mounted thick-client PC capable of communicating with the Ignition HMI servers.

5. Networking equipment shall be provided.

    a. Site standard fiber optic network utilizes OM1 multi-mode fiber. Any internal System networking interfaces not using Category (Cat) 6 Ethernet cable shall be accomplished with a fiber optic patch panel capable of 12-strand, 62.5-micron OM1 ST fiber terminations.

    b. Interface between System and plant SCADA system shall be via Cat 6 Ethernet cable connected to a Contractor-provided network cabinet. System Supplier shall furnish a managed industrial Ethernet network switch in accordance with the requirements of Section 40 66 00 – Network and Communication Equipment.

    c. The System Supplier shall provide all necessary media converters.

6. The System Supplier shall furnish a fully programmed and operational control system including PLC logic and graphic displays of the entire System with real-time data, alarm monitoring, control, trends and reporting, operator log in, and all other services required for the operation and monitoring of the System. Graphic screens shall be designed to closely mimic existing plant standards (i.e., approach, look and feel, and colors) and shall be subject to Engineer's review and approval. Any changes requested by Engineer to align screens with existing standards shall be made at no additional cost to Owner.

7. The control system shall be fully designed, assembled, and programmed at the factory prior to shipment for field installation.

    a. Factory acceptance tests (FATs) shall be conducted for both the hardware and software components of the control system. The FATs for the hardware and software shall occur prior to shipment to the Project site. System Supplier shall make arrangements for witnessed testing by Owner and/or Engineer to be conducted both in person and virtually.

b. Contractor shall coordinate with System Supplier and their other suppliers and subcontractors to obtain all necessary components required for testing the fully functional System that are not within the scope of supply of the System Supplier.

C. Instrumentation

1. Instrumentation shall be the System Supplier's standard offerings and as required for a fully functional System. Instrumentation located in areas considered hazardous per NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities shall be rated for the area classification. System Supplier's selected instruments shall meet the following requirements:

a. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.

b. For uniformity, only one manufacturer and model shall be accepted for each type of product. Where differing models are required, equipment from a single manufacturer shall be provided.

c. Equipment shall be designed for the service intended and shall be of rugged construction and ample strength for stresses that may occur during fabrication, transportation, and installation and during continuous or intermittent operation. Equipment shall be adequately stayed, braced, and anchored and installed in a neat and workmanlike manner. Appearance, safety, and utility shall be given consideration in the design of details.

d. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and sturdy and durable construction and shall be suitable for long, trouble-free service.

## 2.32 TOOLS, SUPPLIES, AND SPARE PARTS

A. Spare parts to operate the System during the warranty period shall be furnished. The following spare parts shall be provided, at a minimum:

1. Air Compressor

| Quantity | Description |
|---|---|
| 1 | Maintenance kit |
| 1 | Filter elements |

2. Burner System

| Quantity | Description |
|---|---|
| 2 | UV flame cells |
| 4 | Relays of each type furnished |
| 2 | Thermocouple of each length furnished (complete assemblies with thermowells and mounting hardware) |
| 2 | Ignition plugs |
| 2 | Temperature switches of each type furnished |

3. Screw Conveyors

| Quantity | Description |
|---|---|
| 1 | Bearing of each size and each type furnished |
| 1 | Gasket of each size furnished |

4. Exhaust Gas Air Fans

| Quantity | Description |
|---|---|
| 1 | Set of shaft bearings of each type furnished |
| 1 | Set of V-belts |

5. Dewatered Cake Feed Pumps

| Quantity | Description |
|---|---|
| 1 | Complete uninstalled pump |

6. Off-Gas Particulate Removal and Condensing System

| Quantity | Description |
|---|---|
| 1 | Set of mist eliminator pads of each size furnished |

7. PLC Systems

| Quantity | Description |
|---|---|
| 1 | PLC card of each type furnished |
| 1 | PLC power supply |
| 1 | PLC processor |

8. Thermal Fluid Pump

| Quantity | Description |
|---|---|
| 1 | Complete uninstalled pump |
| 1 | Shaft mechanical seal assembly |
| 1 | Shaft coupling assembly |

9. Thermal Fluid Thermocouples and RTDs (not otherwise noted)

| Quantity | Description |
|---|---|
| 1 | Thermocouple and RTD of each type and each length furnished |

B. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

C. Spare parts shall be packed in individual, suitable containers clearly labeled with the part number, name, quantity, and the equipment with the Project number and purchase order number for which they are intended. All spare parts shall be furnished in moisture-proof boxes designed to provide ample protection for the contents.

D. Spare parts shall be delivered at the same time as acceptance of the equipment to which they pertain.

E. Special tools required for maintenance of the System, or any of the System components furnished herein under this scope of supply, shall be provided in a quantity of at least one set.

## PART 3 – EXECUTION

### 3.01 GENERAL VERIFICATION OF CONDITIONS

A. All fuel and water utilities required for the testing specified in this Part will be supplied by the Owner at the rate and in the quantities designated within this Section.

B. The Owner will retain the services of an independent certified third-party laboratory to provide analytical services for the field and performance testing.

C. Reports from the System Supplier that rely on data generated by the third-party laboratory shall be due at the specified interval after the laboratory results are provided to the System Supplier.

## 3.02 INSTALLATION

A. The Contractor, in accordance with approved System Supplier's drawings, approved Engineer's drawings and instructions shall install the equipment. System Supplier shall furnish necessary oil and grease for initial operation and making final adjustments to place the equipment in operable condition.

B. Equipment shall be rigidly and accurately anchored into position and carefully coordinated with all connecting pieces of equipment. The System Supplier shall supply all necessary anchor bolts, nuts, washers and plates for installation of equipment provided under this Section. Shims, as required for leveling, shall be furnished by the Contractor.

## 3.03 FIELD TESTING – GENERAL

A. Field tests shall consist of Mechanical Tests, Control System Tests, Integrated System Tests, and Process Performance Tests of the entire System as described in PART 3 of this Section.

B. The Contractor shall have available to the System Supplier sufficient personnel of relative trades to assist with the Mechanical Tests and Integrated Systems Tests as well as perform punch list items.

C. The System Supplier shall provide sufficient staff of skilled operators to supervise and conduct the Mechanical Tests, Control System Tests, Integrated System Tests, and Process Performance Tests. The System Supplier shall provide access for a reasonable complement of the Owner's staff to accompany and observe the System Supplier's staff throughout these tests. The System Supplier shall thoroughly document the results of all tests (Mechanical, Control System, Integrated System, and Process Performance) and equipment servicing (pre-warranty and warranty period) of suitable form and content to the Engineer and the Owner.

D. Field test shall verify that all stated equipment and inputs, outputs and control algorithms are in the working condition specified.

E. Any defects in the equipment or operating controls or failure to meet any requirements of the Specifications shall be promptly corrected by the System Supplier or Contractor at no additional cost to the Owner.

## 3.04 MECHANICAL TESTS

A. Conduct a Mechanical Test of each installed piece of equipment. The Mechanical Tests shall demonstrate that each unit:

1. Has not been damaged by transportation or installation.

2. Has been properly installed.

3. Has no mechanical defects.

4. Is free of overheating of any parts.

5. Is free of all objectionable vibration.

6. Is free of overloading of any parts.

7. Is free of excessive noise.

8. Has all interlocks operating correctly.

B. No handling or processing of either dewatered sludge cake or recycle material by any equipment and/or system shall take place during the Mechanical Tests.

C. System Supplier shall mechanically test all major pieces of equipment and systems.

D. At least 30 days before the scheduled date of any Mechanical Test, the test procedure to be followed shall be submitted to the Engineer for review. Mechanical testing shall not start until the Engineer has reviewed the test procedure. The Engineer must approve subsequent modifications. The Engineer reserves the right to modify the submitted test procedures as conditions warrant in consultation with the System Supplier. All testing shall be done to the Engineer's satisfaction. The Mechanical Tests shall proceed within 7 calendar days after the issuing of the notice-to-proceed for the Mechanical Tests program.

## 3.05 CONTROL SYSTEM TESTS

A. The complete control system as specified herein shall be tested to confirm that the System meets or exceeds the specified requirements. Tests shall cover the full operational range or capability of the System and shall include, but not be limited to:

1. Signal verification (check or correct voltages, current polarity, contact "sensor", etc.)

2. Database verification (check for correct range, alarm limits, engineering units, message repairs, etc.)

3. Operator input to the controls system

4. Verification of application software

5. Alarm log and display generation

6. HMI

B. All field instrumentation and controls that are an integral part of the equipment being tested shall also be tested.

C. Any defects in the equipment or operating controls or failure to meet the requirements of the Specifications shall be promptly corrected at no additional cost to the Owner.

## 3.06 INTEGRATED SYSTEM TESTS

A. Upon successful completion of the Mechanical Tests and Control System Tests, an Integrated System Test using as much field equipment as possible shall be performed.

B. The Integrated Systems Tests shall demonstrate successful functioning of the System and all its elements and software capabilities through planned test cases with actual System online operating conditions.

C. All process and control functions shall be tested, as well as designated combinations and logical sequence.

D. Operation of I/O peripherals shall be checked out.

E. During the Integrated System Tests, the System shall process dewatered sludge and demonstrate that the System can function continuously and reliably and produce a granular dried product. The Owner will be responsible for supplying dewatered sludge required for initial startup.

F. The System Supplier shall notify the Owner at least 96 hours prior to the Integrated Systems Tests so that the Owner can arrange for supplying dewatered cake to the System during the test period.

G. All completed tests, malfunctions, corrective measures, and downtime shall be chronologically logged.

H. The Integrated System Tests shall be completed before the System Supplier conducts the Process Performance Tests as specified in Article 3.07 herein.

I. During the Integrated System Tests, the System Supplier shall provide all personnel to operate the System to perform the tests and analyze samples.

J. The Integrated System Tests shall consist of at least 3 consecutive 8-hour days of System operation.

## 3.07 PROCESS PERFORMANCE TESTS

A. General

1. Process Performance Tests shall be conducted on the System to demonstrate that the System is operating properly and is capable of meeting the performance guarantee criteria specified.

2. The Process Performance Tests shall consist of two independent test runs each with a minimum duration of at least 12 hours of operation. The 12 hours of

operation during the test run shall be continuous and without interruption to the thermal drying unit process. During the test run, data shall be generated to clearly demonstrate that the performance criteria have been achieved by the System.

3. The System Supplier shall submit a detailed scope of work and testing plan ("Process Performance Tests Protocol") for the Process Performance Tests at least 60 calendar days prior to the initiation of the Process Performance Tests.

4. The Owner and System Supplier shall jointly plan the performance and execution of the Process Performance Tests and the System Supplier's representative shall direct all operations during the Process Performance Tests.

5. The Owner will provide electrical power, cooling water, NG fuel, and other utilities and consumables as required for operating the System during the performance of the Process Performance Tests. The System Supplier shall provide operating personnel for the System during the Process Performance Tests.

6. At the commencement of the actual Process Performance Tests, the Owner will establish to the System Supplier's reasonable satisfaction that the Performance Conditions specified as follows have been achieved.

7. The Process Performance Tests shall be conducted only after the successful completion of the field Mechanical tests, Control Systems Tests, and Integrated Systems Tests have been completed to ensure that all the equipment is in operating condition and is ready for the Process Performance Tests.

8. The Process Performance Tests must begin no later than 30 calendar days after the Initial Continuous Operation Date. The "Initial Continuous Operation Date" shall be the first date on which the System has completed 5 days of continuous operation. Continuous operation shall be defined as operation for 8 or more consecutive hours during a 24-hour period. For determination of the initial continuous operation date the continuous operating days need not be consecutive calendar days.

9. For the Process Performance Tests to be deemed satisfactory each of the performance guarantee criteria must be simultaneously achieved, or exceeded, during both independent test runs.

10. If the System achieves a satisfactory Process Performance Tests, the System Supplier shall have no further obligations with respect to demonstrating the performance guarantee.

11. If the System does not demonstrate satisfactory Process Performance Tests in which all of the Performance Conditions have been met, the System Supplier shall have up to 180 calendar days from the beginning of the first Process Performance Test to satisfactorily conduct a Process Performance Test. This time period (the "Test Limitation Period") shall be extended for a period of time equal to the time

lost by reason of any delay resulting from the actions of the Owner, third parties, acts of force majeure, delays caused by equipment outside the supply of System Supplier and other causes outside of System Supplier's reasonable control. Claims for extension of the test limitation period shall be made within 7 calendar days of the start of the period for which a claim for extension shall start.

12. The exclusive means for determining whether a satisfactory Process Performance Test has been conducted and the performance guarantee criteria demonstrated shall be by the test of the System in accordance with procedures set forth in this Section.

B. Process Performance Test Report

1. A Process Performance Test Report shall be prepared for each Process Performance Test conducted to document the performance and results of the Process Performance Tests.

2. The Process Performance Test Report shall be submitted within 30 calendar days after completion of the Process Performance Tests and receipt of analytical data from the analytical laboratory.

3. A minimum of six copies of the Process Performance Test Report shall be submitted with the following information:

a. The date and time of the test.

b. Written narrative (text, tables, and graphs) clearly summarizing the results of the test with respect to demonstration of the performance guarantee data.

c. A description of all sample collection and measurement techniques.

d. Raw data collected from the SCADA system or field during the performance of the tests. Field data sheets bound in the reports shall be copies of the original data sheets collected during the test. Original data sheets shall be provided in a separate bound volume and shall contain original dated signatures (on each sheet) of the System Supplier's and Owner's representatives attesting to their accuracy and original nature.

e. Copies of all laboratory reports for all parameters analyzed during the performance of the test including chain of custody forms. Original lab data sheets shall be provided in a separate bound volume and shall contain original dated signatures (on each sheet) attesting to their accuracy and original nature.

f. Narrative descriptions of operations problems, unusual conditions, equipment failures or malfunctions, and other factors adversely affecting

performance of the System observed and recorded during the performance of the test.

g. Engineering calculations which clearly show the performance of the System with respect to the performance guarantee criteria.

C. Performance Conditions

1. Demonstration of the Performance Guarantee Criteria is made expressly subject to the performance conditions (the “Performance Conditions”) having been satisfied at the time the Process Performance Tests are conducted.

2. The Thermal Dryer Facility shall have been maintained in accordance with normal industry practices and the System Supplier’s instructions and according to the procedures set forth in the System Supplier’s O&M manual.

3. The Owner and the System Supplier shall agree prior to the initiation of the Process Performance Tests that the conditions of Item 2 of Paragraph C of Article 3.07 herein have been satisfactorily demonstrated.

4. During the duration of the Process Performance Tests, the Owner will provide a dewatered sludge cake with the characteristics as described in Paragraph A of Article 1.05 herein.

5. The dewatered cake solids content of the samples collected during the Process Performance Tests, averaged over the length of the Process Performance Tests, shall be considered satisfactory demonstration that the dewatered cake solids content criteria of the Performance Conditions was achieved during the testing.

D. Performance Guarantee Demonstration Criteria

1. Subject to the Performance Conditions being satisfied, the System Supplier shall guarantee that the System as described in this Section will satisfactorily perform as stated as follows. The only performance guarantees demonstration criteria made are those stated in this Paragraph D of Article 3.07 herein.

2. Evaporation Rate: The evaporation rate for the System shall be at least 7,200 pounds water per hour.

3. Final Product Dry Solids Content: Final product dry solids content from the System shall be performed on product collected downstream of the dried product cooling equipment, or closest practical point and shall be, on average, not less than 92% dry solids content.

4. Final Product Temperature: Final product temperature shall be measured downstream of the dried product cooling equipment. The final product temperature

shall be not more than 30°F greater than the maximum cooling water (i.e., filtered FE Water) temperature specified in Paragraph J of Article 1.05 herein.

5. Thermal Energy Usage Rate: The thermal energy usage is measured as the unit heat consumption required (Btu) in NG supply to the dryer to evaporate a unit measure of water (pound). For the purpose of calculating the thermal energy usage rate, the LHV for NG shall be the guaranteed heat content of the gas as specified by the utility supplying the gas.

6. Electrical Energy Usage Rate: The electrical energy usage rate shall be the metered usage (KW) incoming to the MCP equipment furnished by the System Supplier under this Section which shall include electrical energy required to run all equipment covered under this Section when operating at, or above, the design evaporation rate.

E. Performance Test Data Collection and Calculations

1. Data Collection Requirements

a. Dewatered Cake Solids Content: Dewatered sludge cake samples shall be collected from the dewatering unit process at approximately 1-hour intervals during the duration of the Process Performance Tests. A minimum of 12 samples shall be collected during an individual Process Performance test. Each sample shall be individually analyzed for total solids content using standard analytical methods. The arithmetic average of the total solids content shall be utilized in calculation of the evaporation rate.

b. Final Product Weight: Final product generated during an individual Process Performance Test shall be collected in an empty trailer or other temporary container furnished by the Owner for the duration of the test. At the conclusion of each individual Process Performance test, the trailer or temporary container shall be emptied and the total weight of final product processed during the test determined.

c. Final Product Dry Solids Content: A total of 12 individual grab samples shall be collected at approximately 1-hour intervals from the final product sampling location during the individual Process Performance Test. Each sample shall be analyzed to determine total solids content using standard analytical methods. The high and low total solids content values shall be discarded and the remaining 10 total solids content values shall be arithmetically averaged to determine the final product dry solids content.

d. Final Product Temperature: Final product temperature shall be measured after the final product cooling step and prior to conveyance to drive-under truck loading. A total of 12 temperature measurements shall be collected at approximate 1-hour intervals during the testing. The high and low temperature values measured shall be discarded and the remaining 10 total

values shall be arithmetically averaged to determine the average final product temperature delivered to drive-under truck loading.

e. Electrical Energy Consumption: Electrical energy consumption (KWH) shall be determined based on metered quantities of electricity utilized during the duration of each individual Process Performance Test. Electrical usage shall be metered at the main feed to the System motor control system. Electrical power consumption shall be based on total power consumption over the course of the test (totalizer) or from the average usage of not less than 12 values collected at approximately 1-hour intervals over the duration of the test.

f. NG Consumption: NG usage (cubic feet) shall be determined based on metered quantities utilized during the duration of the Process Performance Tests. Metered quantities shall be determined from either the gas utility meter or gas metering equipment installed on the thermal drying system inlet gas train (if provided by the System Supplier as part of the gas train equipment for the thermal fluid heater). If two metering systems are provided, the arithmetic average usage recorded shall be utilized to determine NG usage.

g. During the performance of the Process Performance Tests, other data shall be collected as considered necessary to affirm the test and performance requirements. Supplement data collection, and data collection plan, shall be developed and described in the Process Performance Test Protocol

2. Evaporation Rate

a. The evaporation rate shall be determined based on the dewatered cake solids content (“A”), final product weight (“B”), and final product dry solids content (“C”).

b. Final product dry weight (“D”) shall be determined by the final product weight and the final product dry solids content (i.e., D = B * C).

c. Dewatered cake weight (“E”) shall be determined by dividing the Final product dry weight by the dewatered cake solids content (i.e., E = D / A).

d. The total weight of water evaporated during a Process Performance Test (“F”) shall be determined by subtracting the final product weight from the dewatered cake weight (i.e., F = E – B).

e. The evaporation rate (“G”) shall be determined by dividing the total weight of water evaporated during a Process Performance Test by the duration of the test (units of time). Units shall be expressed in pounds (of water) per hour.

3. Final Product Dry Solids Content: The final product dry solids content shall be as determined based on analytical testing of a set of grab samples collected during the duration of the Process Performance Tests as described elsewhere herein.

4. Final Product Temperature: The final product temperature shall be as determined based on a series of measurements collected during the duration of the Process Performance Tests as described elsewhere herein.

5. Electrical Energy Usage Rate

    a. The electrical energy usage rate shall be determined based on the quantity of electrical energy usage during the Process Performance Tests and shall be determined from the measurement of power consumption on the main feed to the System MCP as described elsewhere herein.

    b. The electrical energy usage rate (“P”) shall be calculated as the average electrical energy usage, in kW, during the Process Performance Tests.

6. Thermal Energy Usage Rate

    a. The thermal energy usage rate shall be determined based on the total weight of water evaporated (“J”), the quantity of NG consumed (“L”), and the LHV of the NG supply.

    b. The thermal energy consumed (“M”) during a Process Performance Test shall be determined as the product of the quantity of NG consumed and the heat content of the NG supply (i.e., M = L * LHV)

    c. The thermal energy usage rate (“N”) shall be calculated by dividing the thermal energy consumed during a Process Performance Test by the total weight of water evaporated during the test (i.e., N = M / J).

## 3.08 PROCESS PERFORMANCE TEST REMEDIES AND LIQUIDATED DAMAGES

A. Remedies

1. If the System does not meet the Performance Guarantee requirements as determined by a Process Performance Test in which the Performance Conditions have been met, the System Supplier shall, at their discretion, repair, replace, or modify the System in order to meet the Performance Guarantee, prior to the expiration of the Test Limitation Period.

2. System Supplier shall not be liable for lost production or the Contractor’s or Owner’s lost profit or for any other indirect, special, or consequential damages due to the inability of the System to meet the Performance Guarantee within the Test Limitation Period.

3. If upon expiration of the Test Limitation Period, the System has failed to pass the Process Performance Test in which all of the Performance Conditions have been met, the System Supplier shall pay the Owner, as liquidated damages and not as a penalty, an amount based on the Performance Guarantee parameters achieved in the Process Performance Test as set forth as follows.

4. The remedies and obligations set forth in this Section are the Owner's exclusive remedies and System Supplier's exclusive obligations in the event of failure of the System to meet the Performance Guarantee.

5. The maximum amount to be paid in the aggregate for any and all liquidated damages for failure to achieve the performance criteria under this Section, exclusive of an "excessive non-conformance", shall be $600,000.

B. Evaporation Rate

1. The performance guaranteed evaporation rate is 7,200 pounds of water evaporated per hour of operation.

2. Liquidated damages shall be determined based on the following schedule:

| Evaporation Rate | Liquidated Damages |
|---|---|
| ≥ 7,200 lbs water/hour | $0 |
| < 7,200 lbs water/hour but ≥ 6,750 lbs water/hour | $70,000 per each 100 lbs (water)/hour |
| < 6,750 lbs water/hour | Excessive Non-Conformance |

3. If the evaporation rate achieved in the Process Performance Test is less than 6,750 pounds (water) per hour, the System shall be considered to be in excessive non-conformance with the performance requirement. For an excessive non-conformance condition, the Owner will have the option to exercise liquidated damages for this performance criterion in the amount of $600,000 **or** returning the System to the System Supplier in exchange for a full refund of the System Purchase Price.

C. Final Product Dry Solids Content

1. The performance guarantee criteria are that the final product average dry solids content be greater than 92.0% and that no single final product sample have a dry solids content less than 90.0%.

2. Liquidated damages shall be determined based on the following schedule:

| Final Product Average Dry Solids Content | Liquidated Damages |
|---|---|
| ≥ 92.0% | $0 |
| < 92.0% and ≥ 91.0% | $40,000 |
| < 91.0% and ≥ 90.0% | $80,000 |
| < 90.0% | Excessive Non-Conformance |

3. If the final product average dry solids content in the Process Performance Test is less than 90%, the System shall be considered to be in excessive non-conformance with the performance requirement. For an excessive non-conformance condition, the Owner will have the option to exercise liquidated damages for this performance criterion in the amount of $100,000 **or** returning the System to the System Supplier in exchange for a full refund of the System Purchase Price.

D. Final Product Temperature

1. The performance criterion is that the final product for delivery to drive-under truck loading shall not be greater than 30°F above the maximum cooling water (i.e., filtered FE Water) temperature specified in Paragraph J of Article 1.05 herein.

2. Liquidated damages shall be determined based on the following schedule:

| Change in Final Product Temperature (In Relation to Cooling Water Temperature) | Liquidated Damages |
|---|---|
| ≤ 30°F | $0 |
| > 30°F but ≤ 35°F | $50,000 |
| > 35°F | Excessive Non-Conformance |

3. If the change in final product temperature, in relation to the cooling water temperature, in the Process Performance Test is greater than 35°F, the System shall be considered to be in excessive non-conformance with the performance requirement. For an excessive non-conformance condition, the Owner will exercise liquidated damages for this performance criterion in the amount of $100,000.

## 3.09 ACCEPTANCE

A. Within 30 days of submittal of Process Performance Test Report, the Engineer will notify the System Supplier of acceptance or non-acceptance of the System.

B. The System shall comply with the minimum evaporation rate, product quality (final product dry solids content and product sizing), and fuel consumption requirements, as

set forth in Article 3.07 herein, to pass the Process Performance Tests. If the System fails the Process Performance Tests, the System Supplier shall make whatever adjustments are determined to be necessary at no cost to the Owner and run the Process Performance Tests again. The System Supplier shall be allowed three attempts to pass the Process Performance Tests.

C. In addition to the performance criteria specified in Article 3.07 herein, the Engineer will review the additional measurement and record keeping ensuring that the System as provided by the System Supplier complies with the Specifications. If the data suggests that certain subsystems are not in compliance with specific Sections of the Specifications, the System Supplier will be notified and shall make such adjustments as necessary to achieve compliance prior to acceptance of the System by the Owner.

## 3.10 DUST HAZARD ANALYSIS

A. After successful commissioning and stable operation of the System has been achieved, the Contractor shall procure the services of a qualified firm specialized in performing a Dust Hazard Analysis (DHA) to perform a full DHA on the entire System and the downstream dried product transport and truck loading screw conveyors. Samples of dried product shall be obtained by Contractor and tested to determine combustible properties of the dust generated by the dried product. Minimum properties to test, determine, and evaluate shall be Minimum Explosive Concentration (MEC), Minimum Ignition Temperature (MIT), Maximum Explosive Pressure (Pmax), and Deflagration Index (Kst). The DHA shall identify all dust-related hazards and provide recommendations for housekeeping practices, operational procedures, and equipment and/or System additions or modifications to meet the requirements of NFPA 68 – Standard on Explosion Protection by Deflagration Venting, NFPA 69 – Standard on Explosion Prevention Systems, and any other applicable combustible dust processing and handling codes and standards. One electronic copy and three hard copies of the DHA report shall be submitted to Engineer within 4 weeks after successful commissioning and stable operation of the System.

B. DHA firm shall have a minimum of 5 years of experience of evaluating biosolids thermal drying facilities for combustible dust hazards and compliance with NFPA codes and standards and other applicable codes and standards. DHA firm shall be Dustcon Solutions, Fike Corporation, or equal.

## 3.11 SUPPLEMENT

A. The following supplement, which is included at the end of this Section, is part of this Section:

1. Scope letter (i.e., proposal or quotation) from BCR Environmental dated October 2, 2025

This scope letter (i.e., proposal or quotation) is being provided as an example of the contract that the Contractor will have to agree to with the previously listed System

Supplier prior to commencing with the associated work. The fixed bid price for Bid Item No. 2.1 – Indirect Thermal Sludge Drying System shall include the cost of any and all materials, equipment, labor, tools, indirect costs, overhead, and profit required by the System Supplier to accomplish the scope of work stated in the scope letter (i.e., proposal or quotation) and this Section.

Bid Item No. 2.1 – Indirect Thermal Sludge Drying System shall also include performance of all engineering, drafting, hydraulic calculations, etc. required by the System Supplier to furnish the specified pre-negotiated equipment and professional services; preparation of all required shop drawings and O&M Manuals by the System Supplier; and provision of the assistance of the System Supplier's representatives during construction for installation, testing, startup, and training, all in accordance with the Contract Documents.

Contractor shall incorporate the provisions of this scope letter (i.e., proposal or quotation) and the scope of work described therein in their Bid. Contractor shall not be entitled to additional compensation for different terms and conditions or additional scope desired unless approved in advance by Owner and Engineer in writing. Contractor shall include all additional costs for all materials, equipment, installation, handling, labor, tools, indirect costs, overhead, profit, and other costs required to perform the work that is associated with the indirect thermal sludge drying system but is not provided by the System Supplier for a complete and fully functional installation and implementation of the pre-negotiated indirect thermal sludge drying system equipment and associated professional services in Bid ITEM No. 1 – LUMP SUM WORK of the Bid Form.

**- END OF SECTION -**

# BIO-SCRU® Biosolids Drying System – Scope Letter

| | |
|---|---|
| Prepared for: | Hazen and Sawyer |
| Project: | Fitzgerald Creek WPCP, Thermal Dryer Facility |
| BCR Project Number: | BCR-0402 |
| Date: | October 2, 2025 |

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## 1. SCOPE OF SUPPLY

The below revised scope of supply is included in the proposal for the BIO-SCRU® IC Dryer system, which includes the dryer along with all items required as per original proposal. This revision includes details from the 90% design drawings and specifications for CCWSA Project No. 2022_007, and Hazen Project No. 32307-007, dated August 2025.

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| QTY. | Description | By BCR | Comments |
|---|---|---|---|
| 2 | Dewatered Cake Feed Hoppers | ✓ | The hoppers have a capacity of 30 cubic yards and shall be manufactured with:<br>• Live bottom and Hopper Top wetted parts, SS304 with SS external welded stiffeners. Structural supports of CS - bolted. CS and painted in external system.<br>• Hopper top/Lid: closed with 2 x gravity drop cake inlets from dewatering conveyors, air exchange vent w/ gooseneck/bird mesh, access manways (2), and level transmitter.<br>• Twin (2) live bottom shafted ribbon screws (of stainless steel), with inverter duty motor, zero speed switches.<br>• (2) Leveling screws, with inverter duty motor.<br>• Other instrumentation Includes weight cells, hopper outlet Isolation gate valve (rectangular) with electric automatic operator, and hand/off/auto switch station<br>• Includes custom stainless steel (3/16" thick) adapter chute to connect hopper outlet flange to pump inlet flange, includes bolting and gasketing.<br>• Includes touch up paint kit for external surfaces<br>• Includes air ride style shaft seals for all shaft penetrations (8 per hopper) and an air prep manifold with isolation valve, filter, and individual air pressure regulators. Instrument tubing from manifold to air ride shaft seals included.<br>• Hopper structure designed/certified by PE licensed in GA<br>• BCR will install bearing grease point line extensions to ground level upon consulting with operators for preferred position<br><br>Note 1 |

Contractor Notes:

1. Feed Hopper is delivered fully assembled. Requires lift capacity of 18T. Crane lift preferred using spreader bar. Instruments removed for shipment, stored in crates, require installation on site. Requires electrical and instrument tie ins and anchoring as called for on plans. Anchors supplied by BCR. Adaptor chute requires a field weld between chute and flange face to meet exact installed Z dimension (after pump is set in place and anchored). Hand switches require mounting as per site requirements. Air prep manifold requires contractor to bring compressed air to inlet isolation valve as shown on drawings.


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| QTY. | Description | By BCR | Comments |
|---|---|---|---|
| 2 | Feed Pump Assembly | ✓ | Progressive Cavity Feed Pump, detailed below:<br>• Design Discharge Pressure PSI(G): 300<br>• Motor Horsepower (HP): 25<br>• Pump Make and Model: Netzsch Nemo NM076SO06S36B.2 FSIP.2 (for maintain in place operations)<br>• Temperature probe, with transmitter (4-20 mA) for dry run protection.<br>• Onyx ring with pressure transmitter and local gauge for overpressure protection.<br>• Feed throat pressure transmitter (4-20 mA) and diaphragm isolator for underfeed protection.<br>• Includes 12” 300# automated (electric actuator) gate valve (DeZurik or equal) for outlet isolation from shared discharge line.<br>• Includes Boundary layer injection ring for potential future use (if required) – does not include BL injection pump/system<br>• Hand/Off/Auto switch station<br><br>Note 2 |
| 1 | Feed Piping System | ✓ | Dewatered Solids Piping system, detailed below:<br>• Detailed design of Piping system, including isometric drawings, assembly drawings - to ASME B31.1 design<br>• Supply of all required Pipe, fittings, gaskets, bolting, instruments, and ground mounted supports to suit.<br>• Piping system to be 304 stainless steel pipe, Sch40, joint system to be grooved fittings, with SS hardware.<br>• Includes main line expansion fitting coordinated with dryer thermal expansion (of CS/DI, with appropriate galvanic corrosion isolation, mounted inside).<br>• Piping supports to be hot dipped galvanized or SS304, with feet for anchoring (structural supports to designed/stamped by PE licensed in GA). Where galvanized, appropriate galvanic corrosion isolation shall be provided.<br><br>Note 3 |

Contractor Notes:

2. Feed Pump is delivered with instrumentation removed and in crating. Reassembly of instrumentation required at site, as well as installation in concert with hopper and feed chute adapter. Hand switch requires mounting as per site requirements. Requires electrical and instrument tie ins and anchoring (supplied by BCR) as called for on plans.
3. Feed piping system is delivered disassembled, with match marking for assembly instruction. Due to field variances from design, a minimum of two field welds per axis (X, Y, Z) should be planned for by contractor, during assembly and fit-up. Contractor is responsible for any heat tracing/insulation (not included by BCR). BCR supplies required anchor bolts.


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| QTY. | Description | By BCR | Comments |
|---|---|---|---|
| **Indirect Screw Dryer** | | | |
| 1 | Dryer | ✓ | BIO -SCRU® IC 10000 Dryer with integrated HOLO -SCRU® rotors - CS MOC<br>With structural support legs<br>Note 4 |
| lot | Dryer Access Platform and Stairs | ✓ | As per project specification (to be designed/stamped by PE licensed in GA).<br>Note 5 |
| 1 | Discharge Conveyor | ✓ | Discharge Screw Conveyor 304SS MOC Housing and Carbon steel Auger.<br>Note 6 |
| 1 | Cooling Screw | ✓ | Hollow Shaft Design w/ a Tubular Housing complete w/ Support Stand (to be designed/stamped by PE licensed in GA) - 304SS MOC wetted materials, CS Jacket MOC<br>Note 7 |
| 1 | Rotary Valve | ✓ | Motor-driven, 304SS wetted materials<br>Note 8 |
| 1 | Condenser System | ✓ | 3-stage, spray, direct-contact with separator tank with drain trap, 304 and 316SS MOC<br>Note 9 |
| 1 | Oxygen Sensor | ✓ | Located at vent, 0-21%v/v. Meets NFPA 69 requirements<br>Note 10 |
| 1 | Foul (Exhaust) Fan | ✓ | Stainless Steel Blower -Radial fume exhauster, 1.5 HP, 1800 RPM, 460VAC/3P/60Hz<br>(New York Blower, Compact GI Size 105)<br>Note 11 |
| 1 | Dryer Thermal Fluid Piping Manifold | ✓ | Dryer Thermal Fluid Distribution Manifold w/ Isolation Valves and instruments (Located on Dryer Skid)<br>Note 12 |

Contractor Notes:

4. The dryer is delivered preassembled to skid, with all on skid instruments pre-wired to RIO panel. Structural legs are delivered unassembled to dryer for shipment height limitations. All items on the skid are pre-insulated or provided with removable insulation blankets if access required. Contractor to provide lift of dryer (50T) to assembled, anchored legs, and assemble with bolts after leveling/anchoring (BCR supplies all bolting and anchor bolts). RIO panel requires electrical, data, and instrument tie in on site.
5. Access platform is minorly disassembled (left as whole as possible to ship), legs separate from platform sections, railing with toe board, stairs etc. Requires site assembly after factory assembly, match mark, knockdown process. BCR supplies all bolting and anchor bolts.
6. Discharge conveyor is shipped separately on pallet, to be assembled as a single piece to dryer/cooling screw. Temperature sensor and zero speed switch to be reassembled on site


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(shipped in instrument crating). Requires electrical and instrument tie in. Requires re-assembly of BCR provided insultation blanket after mechanical and electrical installation.

7. Cooling screw is shipped separately on pallet(s), to be assembled to dryer/cooling screw. The piping associated with the cooling screw requires field re-assembly after factory assembly, match mark, knockdown. Requires electrical and instrument tie in. Supplied with stanchion ground mounted support and bolting, includes anchor bolting. Includes temporary/mobile access platform coordinated with owner preference (forklift or standalone) to service elevated components.
8. Rotary valve is shipped separately on pallet, to be assembled to cooling screw outlet. The zero-speed switch will be shipped in instrument crating and require assembly to rotary valve by contractor. Requires electrical and instrument tie in.
9. Condenser is shipped in 3 major sections, with hoses and instrumentation separately. Requires site re-assembly after factory assembly, match mark, knockdown. Requires instrument tie in. Includes supply of multiple loose instruments that are incorporated downstream of condenser into contractors scope of piping.
10. O2 sensor is shipped separately in instrument crating, requires mechanical assembly to condenser and instrument tie in.
11. Foul air fan assembled as a factory unit, requires placement and connection to condenser foul air outlet and electrical tie in. Anchor bolting supplied by BCR.
12. Dryer thermal fluid manifold is shipped on pallets. Requires site re-assembly after factory assembly, match mark, knockdown. Requires instrument install and tie in. Hot Oil rotary union requires millwright assembly to tight tolerance and specific procedure (Hold point for BCR to supervise).


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| QTY. | Description | By BCR | Comments |
|---|---|---|---|
| **Nitrogen Generator** | | | |
| 1 | Air Compressor | ✓ | Fully automatic system and includes following components:<br>• Oil Injected Screw Air Compressor (15 hp)<br>• Refrigerant dryer<br>• 120-gallon dry air receiver tank<br>• Oil/Water Separator/Filter for condensate<br>• All necessary pressure instrumentation & control system.<br>Note 13 |
| 1 | Nitrogen Generator | ✓ | Fully automatic system and includes following components:<br>• Coalescing/Charcoal/Particulate Pre-Filter<br>• PSA Nitrogen generator<br>• 80 Gallon receiver tank<br>• Incoming Air Pressure Dew Point, and outgoing Nitrogen product Oxygen Analyzer<br>• All necessary pressure instrumentation & control system.<br>Note 14 |
| 1 | Nitrogen/Air Piping System | ✓ | Small diameter piping system includes following components:<br>• All required piping, supports, valves, fittings to distribute nitrogen and compressed air to the required usage points on the thermal dryer system.<br>• Supports assumed to be Unistrut mount, rigid support with cushion isolator from ground or overhead<br>Note 15 |

Contractor Notes:

13. Air compressor and air dryer is a cabinet type (combined in a single cabinet). Shipped on pallet to site (including loose receiver tank, and oil/water separator). Requires site assembly to factory direction, with anchoring, interconnecting piping, electrical and instrument tie in to plans.
14. Nitrogen Generator is a cabinet type. Shipped on pallet to site (including loose receiver tank, combo air filter). Requires site assembly to factory direction, with anchoring, interconnecting piping, electrical and instrument tie in to plans.
15. Nitrogen/Air piping system is predesigned, and comes with installation diagrams/instructions. Pipe sections come in standard lengths, so cutting is required. Fittings are push to connect type (RapidAire or eq.). Standard Unistrut materials and supports supplied (HDG), to be applied as directed, but requires cutting, fixing (BCR supplies anchor bolts as required).


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| QTY. | Description | By BCR | Comments |
|---|---|---|---|
| **Thermal Fluid Heater** | | | |
| 1 | Thermal Fluid Heater System | ✓ | Skid Mounted package as detailed below.<br>• Heater: 12 MMBTU/hr w/ low (NOx) emissions burner.<br>• NEMA 4x UL listed panels, one for burner/fuel train controls, the other for motor controls (mounted on equipment)<br>• One (1) centrifugal pump for circulation of thermal fluid. One additional spare pump (with motor – complete) supplied as shelf spare.<br>• One (1) Combustion Fans integrated to burner<br>• NFPA 85 fuel train (NG)<br>• 1000 gallon thermal fluid expansion tank with Nitrogen gas Blanket.<br>• 200 gallon catch tank complete with a relief port<br>Note 16 |
| 1 | Thermal Fluid Stack | ✓ | Stainless Steel Exhaust Stack as per design drawings/spec<br>• Includes self supported stack with base (to be designed/stamped by PE licensed in GA), barometric damper, sample ports<br>Note 17 |
| 1 | Thermal Fluid Piping System | ✓ | Thermal Fluid Piping system, detailed below:<br>• Detailed design of Piping system, including isometric drawings, assembly drawings - to ASME B31.1 design<br>• Supply of all required Pipe, fittings, gaskets, bolting, valves, instruments, insulation, and ground mounted supports to suit. Expansion fittings included to suit thermal expansion stress relief.<br>• Piping system to be carbon steel Sch 40, externally painted with approved coating system, joint system to be 300# flanged.<br>• Piping supports to be hot dipped galvanized, with feet for floor anchoring.<br>Note 18 |
| 1 | Thermal Fluid Filter (Side Stream) | ✓ | Skid Mounted package as detailed below.<br>• Side stream filter, housing 6 x 30” L x 2.5” OD cartridge filters<br>• With isolation valves, pressure gauges, and indicating flow- meter.<br>• Integrated drip pan<br>Note 19 |

Contractor Notes:

16. Thermal Fluid Heater is modularly disassembled to shipping dimensions and laid flat due to overhead height. Max lift 20T. Requires site assembly after factory assembly, match mark, knockdown. Requires re-terminating uninstalled instruments from factory, electrical and instrument tie-in. BCR to supply anchor bolting.
17. Thermal Fluid Stack is shipped in sections, with butt welding required to install sections (by contractor), comes with detailed instructions for assembly. Includes a heat barrier that


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is ground mounted to avoid insulation within OSHA boundary limits. Contractor to plan for/design wall interface/flashing.

18. Thermal Fluid Piping System is prefabricated, match marked and shipped separately on pallets. Contractor to install. Plan on at least 2 field welds in all axes (X,Y,Z). Insulation is not prefabricated, but included as material only, for installation by contractor after erection, testing and paint touch up. Anchor bolting is included by BCR.
19. Thermal Fluid Filter (Side Stream) shipped factory assembled as a single unit, requires contractor tie in to hot oil plumbing (supplied by BCR). Anchor bolting is included by BCR. Supplied with 24 x 100 micron filters, and 16 x 50 micron filters.


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| QTY. | Description | By BCR | Comments |
|---|---|---|---|
| **Odor Control Units** | | | |
| 1 | Dryer Foul (exhaust) Air Odor Filter | ✓ | Solid media Chemisorption unit includes:<br>• No fan (Passive), media tank capable to 500 cfm flow rate.<br>• Chemisorption Media (17 ft3), mist eliminator, DP gauge, Mounted on Aluminum channel skid<br>Note 20 |

Contractor Notes:

20. The odor filter tank is shipped on a skid. Contractor to assemble mist eliminator and DP gauge in line with ducting, supported by contractor provided ground mount (Unistrut typical). BCR to supply ducting of 4" CPVC material from foul air blower to odor filter. Contractor to supply duct mounting and supports.


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| QTY. | Description | By BCR | By Contractor | Comments |
|---|---|---|---|---|
| **Electrical & Instrumentation** | | | | |
| Lot | Transmitter/Field Devices | ✓ | | As per BCR and Plan P&ID |
| Lot | Control Panel– PLC/HMI | ✓ | | Includes main control panel, centralized UPS for panel low voltage supply with distribution load center and racking (all in elec. room). Includes thermal fluid heater control panels, and remote I/O panel for dryer. Includes field mounted HOA and E-stop button operator boxes as required per spec and code. Included hardened operator interface terminal for complete operator control near dryer unit (field mounted on included pedestal). |
| Lot | Transformers/Switchgear | | ✓ | |
| Lot | Motor Disconnects | | ✓ | |
| Lot | Variable-Frequency motor drives | ✓ | | Only for BCR Supplied Motors. Supplied in panel format as per specification including power meter. All motors driven by VFD include thermal protection switch in motor. |
| Lot | Supply & termination of power supply to BCR control | | ✓ | There will be multiple panels that power supply needs to be terminated. |
| Lot | Building lighting | | ✓ | |
| Lot | Electrical & Pneumatic works onsite | | ✓ | Components supplied loose or interconnect between the skids |
| **Documentation** | | | | |
| Lot | P&ID | ✓ | | Process & Instrumentation Diagram |
| Lot | Process Flow Diagram (PFD) | ✓ | | |
| Lot | General Arrangement (GA) | ✓ | | Includes Anchor bolts details |
| Lot | Electrical Single Line Drawing | ✓ | | |
| Lot | O&M Manual | ✓ | | Operation & Maintenance Manual |
| **Testing & Inspection** | | | | |
| Lot | Factory Acceptance Test | ✓ | | At BCR fabrication facility |
| Lot | QC Inspections | ✓ | | BCR Internal Quality Assurance |
| Lot | Field Performance Test | ✓ | | |


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| QTY. | Description | By BCR | By Contractor | Comments |
|---|---|---|---|---|
| **Construction** | | | | |
| Lot | Temporary Facilities | | ✓ | On-site for storage |
| Lot | Site Grading, roads etc., | | ✓ | |
| Lot | Civil/Foundation Work | | ✓ | |
| Lot | Buildings, HVAC, Emission control | | ✓ | |
| Lot | Job Site Unloading & Storage | | ✓ | |
| Lot | Field Installation Labor, Materials, and Equipment | | ✓ | Includes all mechanical piping, duct work & electrical interconnection. |
| **Site Services** | | | | |
| Lot | Packing and Marking for Shipment | ✓ | | |
| Lot | Delivery & freight to job site | ✓ | | |
| Lot | Installation Supervision | ✓ | | Included, as per specification |
| Lot | Start-up and Testing Supervision | ✓ | | |
| Lot | Training of O & M Personnel | ✓ | | |
| Lot | Any Local, State or Federal Permits | | ✓ | |
| **Consumables** | | | | |
| Lot | First Fill of lubricants & chemicals | ✓ | | |
| Lot | Electric Power, Water, and Fuel | | ✓ | For Construction, Pre-commissioning, Start-up, and Operation |
| Lot | Spare Parts | ✓ | | See Section 3 for Preliminary Spare parts list, as per specification requirements |


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## 2. PRICING & TERMS

| Item | Qty | Item Description | Price/Unit | Total price |
|---|---|---|---|---|
| Dryer System | 1 | IC-10000 Dryer System as above scope of supply | $11,179,582 | $11,179,582 |
| Site Labor | 1 | Site labor as described in above scope of supply | $245,000 | $245,000 |
| Spare Parts | 1 | Spare Parts as per Manufacturer recommendation and specification required | $121,000 | $121,000 |

**Incoterms:** FOB, Jobsite (Attn: [Contractor], 260 Colemans Bluff Drive, Woodstock, Georgia 30188)

**Price Validity:** January 31,2026.

**Notes:**

1. Standard Incoterms apply to Delivery.
2. Prices assume delivery of equipment to site by Q1 2027
3. *All Prices are in US Dollars. Price does not include any local, state or federal taxes or custom duties or other taxes.*
4. *BCR Inc. Standard Terms and Conditions will apply to items or equipment purchased under this proposal.*
5. *Equipment sold by BCR contains intellectual property; BCR will not transfer title to such intellectual property by way of sale of equipment. Drawings and data provided will remain the property of BCR.*


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## 2.1 PAYMENT TERMS

5% at purchase order approval
20% with approved submittal drawings (as per schedule of values)
25% with release to manufacture (as per schedule of values)
40% with equipment delivered to site (as per schedule of values) NTE 45 days from BCR notification of equipment ready to ship
10% with completion of start-up and training

The formal contract between the Contractor and BCR Environmental, which shall be based on this scope letter (i.e., proposal), for this pre-negotiated equipment and these professional services shall be subject to the requirements of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements, including, but not limited to, those for payment terms, withholding of retainage, and non-responsiveness, of the Contractor's construction Contract with the Owner (Cherokee County Water & Sewerage Authority) for this Project. However, the Owner will make partial payment to the Contractor for purchase order approval, approved submittal drawings, release to manufacture, delivery of equipment, and completion of start-up and training in accordance with the payment terms listed in this quotation.

The NTE dates of terms above relay clarity on project timing when delays occur that are NOT attributable to BCR.

If long term outdoor storage is required (> 14 calendar days), additional preparation costs will be provided to prepare equipment for long term outdoor storage, or an alternative storage arrangement (at manufacturer) and ship in place can be provided – with potential costs.

Partial payment percentages exclude the cost of site labor (installation supervision, checkout and startup, training, etc.), which shall be invoiced after completion of said labor.


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**3. 2025 FIELD SERVICE RATES**

Purpose: To set standard labor rates for non-contracted work.
Term: Effective 02/01/2025 until further notice.

**3.1 Services Included**:

The proposal includes services of system trained representative(s) as detailed below:

| Purpose | Number of Days |
|---|---|
| Installation Supervision services (one tech/engineer) | 10 Days, 2 Trips |
| Checking equipment after contractor Installation Mechanical (one tech, one engineer) | 5 Days, 1 Trip |
| Control System tests after contractor installation (one tech, one engineer) | 5 Days, 1 Trip |
| Integrated System Test Commissioning (one technician, two engineers) | 5 Days, 1 Trip |
| Performance Test (one technician, two engineers) | 5 Days, 1 Trips |
| Training (one engineer) as per specification | 11 Days, 3 Trips |
| MCC/VFD Commissioning (one engineer) | 3 Days, 2 Trip |
| Follow up Graphic Screen Development (one engineer – remote) | 2 Days, 0 Trip |

**3.2 Other, Non-Contracted Service Rates**:

Provide repair and maintenance services as requested at the following discounted service agreement rates:

Field Service Normal Rates:

Mon-Fri..... $188/HR

Sat/Sun/Holidays..... $376/HR

Overtime Rate ..... $282/HR Travel Rate

..... $136/HR Expenses – Actual expenses for travel, lodging, & meals.

Engineering & Project Management Normal Rates:


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Mon-Fri…… $214/HR

Sat/Sun/Holidays…… $430/HR

Travel Rate …… $136/HR Expenses – Actual expenses for travel, lodging, & meals.


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**3.3 Manufacturer Recommended Spare Parts Included**:

| Part Description | Quantity |
|---|---|
| Hopper flange gasket set | 1 Set |
| Dryer, Condenser, Discharge and Cooling screw flange gasket set – includes all dryer housing gaskets | 1 Set |
| Thermal fluid special gaskets | 1 Set |
| Rotary Joint rebuild kit | 2 Set |
| Solid lube bearing carbon liner replacements | 2 Set |
| 3/4" and ½" John crane packing (each) | 50 ft |
| Thermocouple 12" long | 2 |
| Thermocouple 24" long | 2 |
| Air compressor and Nitrogen PM kit (2 yrs) | 1 Kit |
| Thermal fluid heater cartridge filters | See section above for detail |
| Thermal fluid heater pump rebuild kit | 1 Kit |
| Oxygen sensor PM | 1 Kit |
| Progressive Cavity Pump Recommended spares | 2 Kit |
| Recommended Electrical and Control spares | 1 Kit |

Notes:

1. BCR will confirm the above list after the completion of the detailed design. The price for the above list and final list is in BCR's scope of supply and shall meet specification required spares for all BCR provided equipment.


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## 4. TERMS AND CONDITIONS OF PURCHASE

1. **TERMS APPLICABLE:** The Terms and Conditions of Sale listed below are the exclusive terms and conditions applicable to quotations made and orders acknowledged by BCR Environmental, Corp. ("Seller") for the sales of products, equipment and parts relating thereto ("Products"). This quotation or acknowledgment is expressly made conditional upon Buyer's assent to such terms and conditions. Any of Buyer's terms and conditions which are in addition to or different from those contained herein, which are not separately agreed to by Seller in writing, are hereby objected to and shall be of no effect. Objections to any terms and conditions contained herein shall be deemed waived if Seller does not receive written notice thereof within 20 days of the date of this quotation or acknowledgment. Buyer in any event will be deemed to have assented to the terms and conditions contained herein if delivery of any Product is accepted. The term "this Agreement" as used herein means this quotation or acknowledgment or purchase order, together with BCR's proposal and any attachment hereto, any documents expressly incorporated by reference and these Standard Terms and Conditions of Sale. Terms are cash unless otherwise agreed upon in writing.

2. **TERMS OF PAYMENT**: All invoices are due and payable in Jacksonville, FL. All credit sales are due in full according to the schedule in the proposal Payment Terms. Accounts past due shall accrue interest at 2% per month or the highest lawful rate allowed by applicable law. Prices and design are subject to change without prior notice.

3. **ACCEPTANCE:** The terms and conditions of this Offer for Sale shall apply and become a part of the contract between Seller and Buyer unless specifically changed in writing and signed by an executive officer of Seller. The terms and conditions of this Offer for Sale shall in all cases, without exception, control and take precedence over any terms and conditions in Buyer's acceptance. Buyer's acceptance of this Offer for Sale shall be prima facie evidence of acceptance by Buyer of Seller's terms and conditions as controlling. Any conflicting terms and conditions in any document (including our proposal), Buyer's purchase order, acknowledgement or other document utilized by Buyer in this transaction, are expressly rejected by Seller.

4. **FORCE MAJEURE:** (a) Force Majeure Defined. For the purpose of this Agreement "Force Majeure" will mean all unforeseeable events, beyond the reasonable control of either party which affect the performance of this Agreement, including, without limitation, acts of God, acts or advisories of governmental or quasi-governmental authorities, laws or regulations, strikes, lockouts or other industrial disturbances, acts of public enemy, wars, insurrections, riots, epidemics, pandemics, outbreaks of infectious disease or other threats to public health, lightning, earthquakes, fires, storms, severe weather, floods, sabotage, delays in transportation, rejection of main forgings and castings, lack of available shipping by land, sea or air, lack of dock lighterage or loading or unloading facilities, inability to obtain labor or materials from usual sources, serious accidents involving the work of suppliers or sub-suppliers, thefts and explosions.

(b) Suspension of Obligations. If Seller is unable to carry out its obligations under this Agreement due to Force Majeure, and the Seller promptly notifies the Buyer of such delay, then all obligation that are affected by Force Majeure will be suspended or reduced for the period of Force Majeure and for such additional time as is required to resume the performance of its obligations, and the delivery schedule will be adjusted to account for the delay.

5. **WARRANTY:** (a) Seller warrants to Buyer that the Products manufactured by it will be delivered free from defects in material and workmanship. This warranty shall commence upon delivery of the Products and shall expire on the earlier to occur of 24 months from initial operation of the Products or 30 months from delivery thereof (the "Warranty Period"). If during the Warranty Period Buyer discovers a defect in material or workmanship and within 10 days of such discovery gives Seller written notice thereof, Seller will either deliver to Buyer a replacement part, or repair the defect at jobsite for non-removable equipment. Seller will pay labor or provide labor. Seller will have no warranty obligations under this paragraph 5(a): (i) if the Products have not been operated and maintained in accordance with generally approved industry practice and with Seller's specific written instructions; (ii) if the Products are used in connection with any mixture or substance or operating condition other than that for which they were designed; (iii) if Buyer fails to give Seller such written notice within 10 day of the discovery; (iv) if the Products are repaired by someone other than Seller or have been intentionally or accidentally damaged; (v) for corrosion, erosion, ordinary wear and tear or in respect of any parts which by their nature are exposed to severe wear and tear or are considered expendable, (vi) if all payments have not been made. If remote monitoring is not enabled, a $2500.00 deductible applies to all Warranty work. Finished materials and accessories purchased from other manufacturers are only warranted to the extent of the original manufacturer's warranty.

(b) Seller further warrants to Buyer that at delivery, the Products manufactured by it will be free of any liens or encumbrances. If there are any such liens or encumbrances, Seller will cause them to be discharged promptly after notification from Buyer of their existence.

(c) **THE EXPRESS WARRANTIES SELLER MAKES IN THIS PARAGRAPH 5 ARE THE ONLY WARRANTIES IT WILL MAKE. THERE ARE NO OTHER WARRANTIES, WHETHER STATUTORY, ORAL, EXPRESS OR IMPLIED. IN PARTICULAR, THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SELLER'S LIABILITY FOR WARRANTY REPAIR OR REPLACEMENT SHALL NOT EXCEED THE AMOUNT PAID BY BUYER FOR THE ITEMS PURCHASED.**

(d) The remedies provided in paragraphs 5(a) and 5(b) are Buyer's exclusive remedy for breach of warranty.

(e) With respect to any Product or part thereof not manufactured by Seller, Seller shall pass on to Buyer only those warranties made to Seller by the manufacturer of such Product or part which are capable of being so passed on.

6. **LIMITATION OF LIABILITY**: Notwithstanding any other provision in this Agreement, the following limitations of liability shall apply: (a) In no event, whether based on contract, tort (including negligence), strict liability or otherwise, shall Seller, its officers, directors, employees, subcontractors, suppliers or affiliated companies be liable to Buyer or any third party for loss of profits, revenue or business opportunity, loss by reason of shutdown of facilities or inability to operate any facility at full capacity, or cost of obtaining other means for performing the functions performed by the Products, loss of future contracts, claims of customers, cost of money or loss of use of capital, in each case whether or not foreseeable, or for any indirect, special, punitive, incidental or consequential damages of any nature.

(b) The aggregate liability of Seller, its officers, directors, employees, subcontractors, suppliers or affiliated companies, for all claims of any kind for any loss, damage, or expense resulting from, arising out of or connected with the Products or this Agreement or from the performance or breach thereof, together with the cost of performing make good obligations to pass performance tests, if


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applicable, shall in no event exceed the lesser of the amount paid by Buyer or contract price. The foregoing notwithstanding, if applicable, any claims for (i) delay in delivery shall not exceed 5% of the sum of money received by Seller and (ii) breach of performance guarantees (if any apply) shall not exceed 10% of the order price.

(c) The limitations and exclusions of liability set forth in this paragraph 6 shall take precedence over any other provision of this Agreement and shall apply whether the claim of liability is based on contract, warranty, tort (including negligence), strict liability, indemnity, or otherwise. The remedies provided in this Agreement are Buyer's exclusive remedies.

(d) All liability of Seller, its officers, directors, employees, subcontractors, suppliers or affiliated companies, resulting from, arising out of or connected with the Products or this Agreement or from the performance or breach thereof shall terminate on the second anniversary of the date of this Agreement.

7. **INDEMNITY:** Buyer agrees to indemnify and hold Seller harmless for loss due to any fines, penalties and corrective measures necessary to comply with laws, rules and regulations, as well as injuries, losses or claims in connection with the Buyer's use or operation of the Products. Seller agrees to indemnify and hold Buyer harmless for loss due to any fines, penalties and corrective measures necessary to comply with laws, rules and regulations in connection with the design or manufacture of purchased Products.

8. **CANCELLATION BY PURCHASER:** The proposed system is sold on a final, non-cancelable, non-returnable, non-refundable basis. Buyer agrees to complete the payment commitments as outlined in the Payment Terms captured in the attached Firm Proposal.

9. **DELIVERY:** The price and delivery of all Products, are Ex Works (according to Incoterms 2010) Seller's factory. All shipments are made Ex Works our plant. If the purchase price has been paid in full prior to shipment, then title to the Products shall pass to Buyer when the Products are duly delivered to the carrier (Carrier) selected by Buyer or, at Buyer's request, by Seller, at Seller's factory, except where Buyer requests a delay in shipment, in which case the title shall pass to the Buyer when the Products are ready for shipment. If Buyer requests a delay in shipment, then Buyer shall pay Seller's standard storage charges for the period from the date Products are ready for shipment to the actual date of shipment, Buyer will provide a certificate of insurance for the product while it is being stored. If the purchase price has not been paid in full, title to Products does not pass from Seller to Buyer until Seller receives payment in full. Buyer expressly agrees not to commercially operate the Products until Seller has received payment in full.

10. **RISK OF LOSS:** The risk of loss to the Products shall pass to Buyer when the Products are duly delivered to the Carrier at Seller's factory or earlier if title passes to Buyer as listed above. The processing of freight claims or loss claims is the responsibility of Buyer.

**11. CONFIDENTIALITY**: Buyer acknowledges that the information which Seller submits to Buyer in connection with this quotation or acknowledgment includes Seller's confidential and proprietary information, both of a technical and commercial nature and it is subject to the Non-Disclose and Confidentiality Agreement executed by Buyer. Buyer agrees not to disclose such information to third parties without Seller's prior written consent. Seller grants to Buyer a non-exclusive, royalty free, perpetual license to use Seller's confidential and proprietary information for purposes of this specific order and the Products that are the subject hereof only. In addition to any separate obligations under the Non- Disclosure and Confidentiality Agreement, Buyer further agrees not to permit any third party to fabricate the Products or any parts thereof from Seller's drawings (or other information) or to use the drawings (or other information) other than in connection with this specific order. Buyer will defend and indemnify Seller from any claim, suit or liability based on personal injury (including death) or property damage related to any Product or part thereof which is fabricated by a third party without Seller's prior written consent and from and against related costs, charges and expenses (including attorney's fees). All copies of Seller's drawings shall remain Seller's property and may be reclaimed by Seller at any time.

12. **INTELLECTUAL PROPERTY**: All intellectual property of Seller shall remain the exclusive property of Seller and no license to pre-existing intellectual property will be created by this Agreement. Any new intellectual property developed by Buyer that includes or incorporates the Products shall also be owned by Seller.

13. **LAW:** The rights and obligations of the parties shall be governed by the domestic laws of the State and County of Cherokee County, Georgia without regard to its conflict of law rules or the United Nations Convention for the International Sale of Goods.

14. **ARBITRATION:** Any dispute, controversy or claim arising under this agreement or the breach thereof, shall be settled by arbitration administered by the American Arbitration Association in Canton, GA Texas, pursuant to the American Arbitration Association Commercial Arbitration rules. The parties shall jointly select one arbitrator and the decision of the arbitrator shall be final and binding on the parties and enforceable in any court of competent jurisdiction. Each party shall bear its own costs and expenses and an equal share of the arbitrator's and administrative fees of arbitration. The prevailing party may, at the arbitrator's sole discretion, award reasonable attorney fees. Except as may be required by law, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties.

15. **ENTIRE AGREEMENT**: This Offer, together with the Non-Disclosure and Confidentiality Agreement ("NDA"), contains the entire agreement between Seller and Buyer, and no modification of this Offer or NDA shall be binding upon Seller unless evidenced by an agreement in writing signed by an executive officer of Seller after the date hereof. No oral or written statements by Seller's sales representatives, or other agents, made after the date hereof shall modify or vary the express terms hereof unless evidenced by an agreement in writing signed by an executive officer of Seller after the date hereof. To the extent any advertising or promotional material of Seller contradicts or disagrees with the terms hereof, Seller and Buyer agree that the terms hereof shall control and that such advertising and/or promotional materials are not part of the Agreement between Seller and Buyer.

16. **SECURITY INTEREST:** To secure payment for Products, Buyer grants to Seller a security interest in the Products and agrees that Seller shall have the rights and remedies of a secured party under the Uniform Commercial Code. Buyer designates Seller as its attorney-in-fact to execute any financing statements on behalf of Buyer necessary to perfect such security interest.

17. **TAXES:** Prices on the products sold buy Seller are exclusive of any city, state, federal or foreign taxes or duties, of any kind. Buyer is responsible for all such taxes and duties and agrees to indemnify Seller for all taxes and duties that may be assessed upon Seller


*This proposal and its contents are the intellectual property of BCR Environmental Corp. and intended for the purposes of the named entity evaluating the proposed equipment for the specific application and project described herein. Any reproduction or redistribution of this proposal to a third party without the written consent of BCR Environmental is prohibited.*

# APPENDIX A

# Geo-Hydro Engineers, Inc. Report of Subsurface Exploration and Geotechnical Engineering Evaluation for Fitzgerald Creek WPCP (Information of Record)

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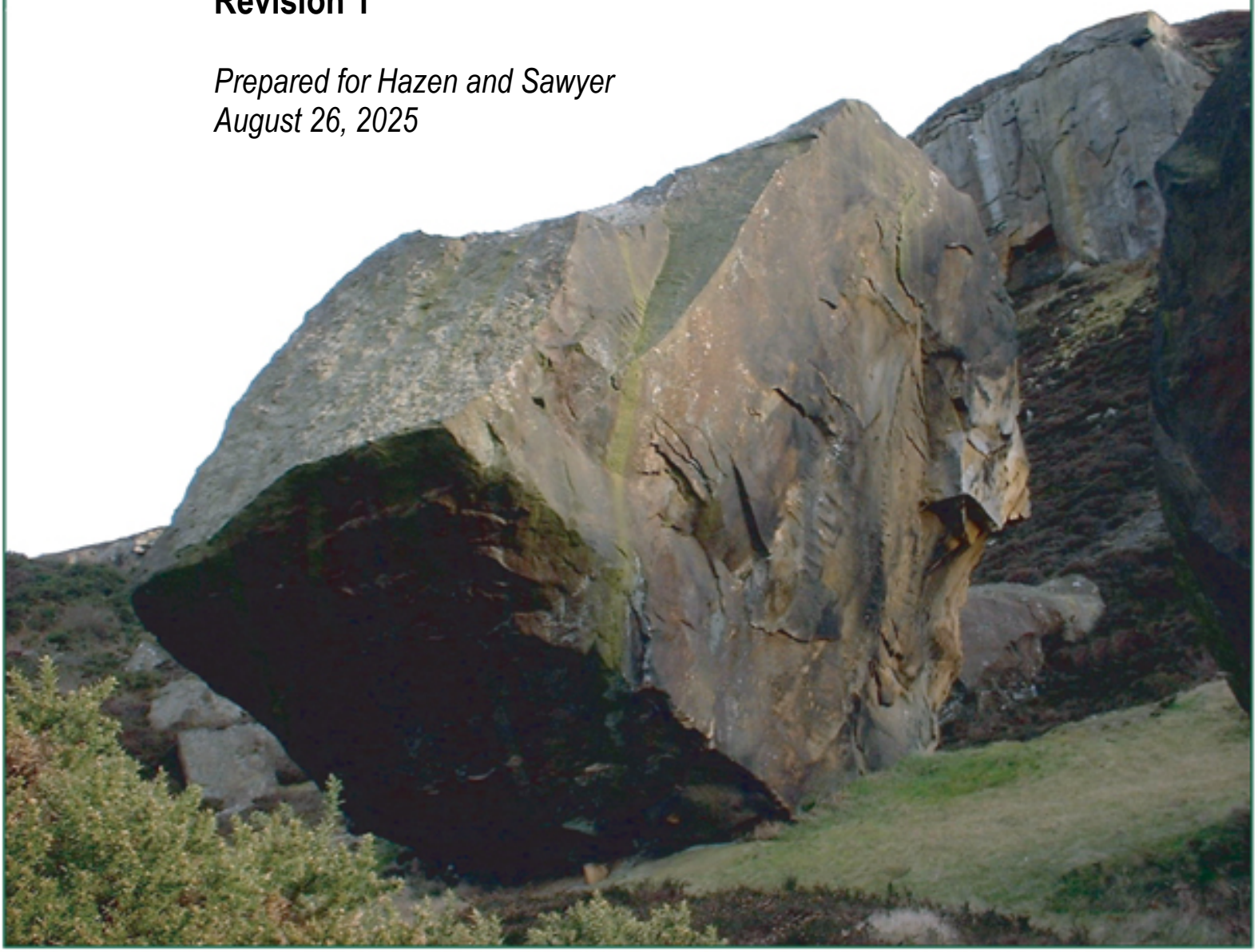
GEO HYDRO ENGINEERS

# Report of Subsurface Exploration and Geotechnical Engineering Evaluation

**Fitzgerald Creek Thermal Dryer Facility**
**Cherokee County Water & Sewage Authority**
**Woodstock, Georgia**
**Geo-Hydro Project Number 251796.20**
**Revision 1**

*Prepared for Hazen and Sawyer*
*August 26, 2025*



Mr. Dan Sebusch
Hazen and Sawyer
1300 Altmore Avenue, Suite 520
Atlanta, Georgia 30342

August 26, 2025

**Report of Subsurface Exploration**
**and Geotechnical Engineering Evaluation**
**Fitzgerald Creek Thermal Dryer Facility**
**Cherokee County Water & Sewerage Authority**
**Woodstock, Georgia**
**Geo-Hydro Project Number 251796.20 Revision 1**

Dear Mr. Sebush:

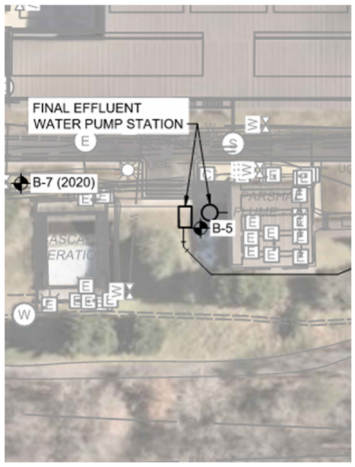
Geo-Hydro Engineers, Inc. has completed the authorized subsurface exploration for the above referenced project. The scope of services for this project was outlined in our proposal number 251796.P0 Revision 1 dated June 25, 2025.

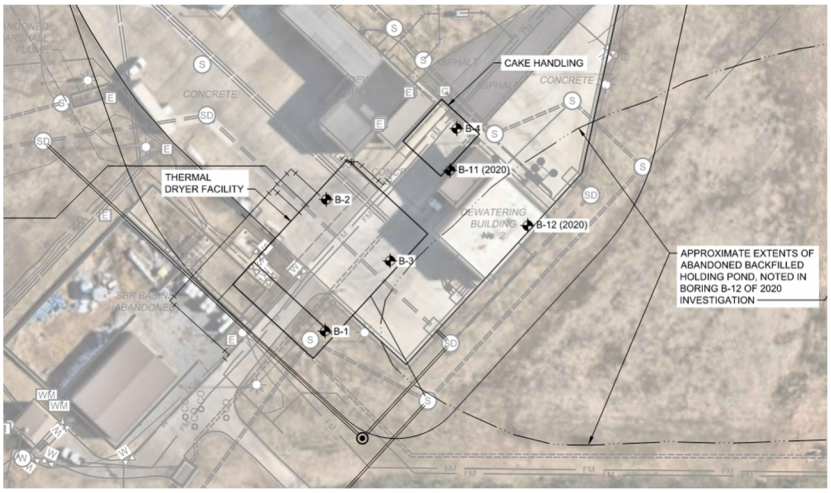
## PROJECT INFORMATION

The overall project will involve the construction of new Cake Handling and Thermal Dryer facilities and an Effluent Water Pump station within the Fitzgerald Creek Water Pollution Control Plant (WCPC) at 260 Colemans Bluff Drive in Woodstock, Georgia. Figure 1 in the Appendix shows the approximate plant location.

We understand that the new Thermal Dryer facility and Cake Feed station will be installed on reinforced concrete mat foundations. Based on information provided to us, the Thermal Dryer and Cake Feed structures will produce estimated bearing pressures of 1,800 and 1,500 psf, respectively. The Effluent Water pump station will produce an estimated bearing pressure of 1,200 psf.

The area of the planned buildings and pump station is currently occupied by landscaping and concrete pavement. Both stations will be constructed adjacent or between existing structures within the facility. Based on our understanding of site grades, mass grading for the dryer facility and cake handling structure will be minimal. In contrast, construction of the pump station will require about 10 feet of mass excavation. The annotated site plan excerpts below show the approximate addition footprints and current site conditions.



The table below was provided to us and summarizes the information developed at the time of this report.

**Table 1: Approximate Elevations and Estimated Bearing Pressures of Proposed Buildings/Facilities**

| Building/ Facility | Approximate Top of Foundation Slab Elevation | Approximate Bottom of Foundation Slab/ Beam Elevation | Approximate Maximum Water Surface Elevation | Approximate Finished Grade Elevation | Approximate Top of Structure Elevation | Estimated Bearing Pressure (psf) |
|---|---|---|---|---|---|---|
| Thermal Dryer Facility | 968.33 | 965.83 (perimeter)<br>966.83 (interior) | N/A | 968.33 | 999.83 | 1,800 (perimeter)<br>900 (interior) |
| Dewatered Cake Feed Station | 969.00 | 967.33 | N/A | 969.00 | 969.00 | 1,500 |
| Final Effluent Water Pump Station | 910.00 | 909.00 | 919.00 | 920.00 | 920.50 | 1,200 |

## EXPLORATORY PROCEDURES

The subsurface exploration consisted of five soil test borings performed at the approximate location shown on Figure 2 in the Appendix. The test borings were located in the field by Geo-Hydro using a handheld GPS unit with preloaded coordinates, and by measuring angles and distances from existing site features The ground surface elevations shown on the test boring records were provided to us and were obtained by a surveyor while we were on site. In general, the boring locations and ground surface elevations should be considered approximate.

Standard penetration testing, as provided for in ASTM D1586, was performed at select depth intervals in the soil test boring. Soil samples obtained from the drilling operation were examined and classified in general accordance with ASTM D2488 (Visual-Manual Procedure for Description of Soils). Soil classifications include the use of the Unified Soil Classification System described in ASTM D2487 (Classification of Soils for Engineering Purposes). The soil classifications also include our evaluation of the geologic origin of the soils. Evaluations of geologic origin are based on our experience and interpretation and may be subject to some degree of error.

Descriptions of the soils encountered in the test boring are provided in the test boring record included in the Appendix. Groundwater conditions, standard penetration test resistances, and other pertinent information are also included.

## REGIONAL GEOLOGY

The project site is located in the Northern Piedmont Geologic Province of Georgia. Soils in this area have been formed by the in-place weathering of the underlying crystalline rock, which accounts for their classification as “residual” soils. Residual soils near the ground surface that have experienced advanced weathering frequently consist of red brown clayey silt (ML) or silty clay (CL). The thickness of this

surficial clayey zone may range up to roughly 6 feet. For various reasons, such as erosion or local variation of mineralization, the upper clayey zone is not always present.

With increased depth, the soil becomes less weathered, coarser grained, and the structural character of the underlying parent rock becomes more evident. These residual soils are typically classified as sandy micaceous silt (ML) or silty micaceous sand (SM). With a further increase in depth, the soils eventually become quite hard and take on an increasing resemblance to the underlying parent rock. When these materials have a standard penetration resistance of l00 blows per foot or greater, they are referred to as partially weathered rock. The transition from soil to partially weathered rock is usually a gradual one, and may occur at a wide range of depths. Lenses or layers of partially weathered rock are not unusual in the soil profile.

Partially weathered rock represents the zone of transition between the soil and the indurated metamorphic rocks from which the soils are derived. The subsurface profile is, in fact, a history of the weathering process that the crystalline rock has undergone. The degree of weathering is most advanced at the ground surface, where fine-grained soil may be present. Conversely, the weathering process is in its early stages immediately above the surface of relatively sound rock, where partially weathered rock may be found.

The thickness of the zone of partially weathered rock and the depth to the rock surface have both been found to vary considerably over relatively short distances. The depth to the rock surface may frequently range from the ground surface to 80 feet or more. The thickness of partially weathered rock, which overlies the rock surface, may vary from only a few inches to as much as 40 feet or more.

## TEST BORING SUMMARY

Starting at the ground surface, borings B-1 and B-5 encountered about 3 inches of topsoil. Borings B-2 and B-3 initially encountered 6 inches of concrete, and boring B-4 initially encountered approximately 5 inches of asphalt underlain by about 12 inches of graded aggregate base.

Below the surface materials, all borings encountered fill materials extending to depths ranging from about 6 to 12 feet. Boring B-5 was terminated in the fill at a depth of 15 feet. The fill was classified as sandy clay, clayey sand, and silty sand with varying amounts of rock fragments. Standard penetration test resistances recorded in the fill ranged from 3 to 23 blows per foot.

Beneath the fill materials, borings B-1 through B-4 encountered residual soils typical of the Piedmont Region. The residual soils were classified as clayey sand and silty sand with rock fragments and varying mica contents. Standard penetration test resistances recorded in the residual soils ranged from 8 to 34 blows per foot.

Partially weathered rock was encountered in borings B-2 and B-4 beginning at depths of about 27 and 37 feet, respectively. Partially weathered rock is locally defined as residual material having standard penetration resistance values greater than 100 blows per foot.

Boring B-2 encountered materials causing auger refusal at a depth of 35 feet. Auger refusal is the condition that prevents advancement of the boring using conventional soil drilling techniques. The material causing auger refusal may consist of a boulder, a lens or layer of rock, the upper surface of relatively massive rock, or other hard material.

At the time of drilling, groundwater was encountered in borings B-3 and B-4 at a depth of 37 feet. For safety reasons, the borings were backfilled with soil cuttings upon completion and patched with asphalt or concrete where appropriate. It should be noted that groundwater level will fluctuate depending on seasonal variations of precipitation and other factors and may occur at different elevations in the future.

For more detailed descriptions of subsurface soil and groundwater conditions, please refer to the test boring records included in the Appendix.

**Test Boring Summary**

| Boring | Ground Surface Elevation | Bottom of Foundation Slab Elevation | Bottom of Fill | | Groundwater* | | Depth to PWR | | Auger Refusal | | Boring Termination | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Depth (feet) | Elev. | Depth (feet) | Elev. | Depth (feet) | Elev. | Depth (feet) | Elev. | Depth (feet) | Elev. |
| B-1 | 966 | 965 | 22 | 944 | NE | --- | NE | --- | NE | --- | 40 | 926 |
| B-2 | 968 | 965 | 12 | 956 | NE | --- | 27 | 941 | 35 | 933 | 35 | 933 |
| B-3 | 967 | 965 | 6 | 961 | 37 | 930 | NE | --- | NE | --- | 40 | 927 |
| B-4 | 969 | 967 | 8 | 961 | 37 | 932 | 37 | 932 | NE | --- | 40 | 929 |
| B-5 | 919 | 909 | >15 | <904 | NE | --- | NE | --- | NE | --- | 15 | 904 |

**All Depths and Elevations in this Summary Table are Approximate**
NE: Not Encountered
PWR: Partially Weathered Rock
*Groundwater level measured at time of drilling

## EVALUATIONS AND RECOMMENDATIONS

The following recommendations are based on the information available on the proposed construction, the data obtained from the soil test boring, and our experience with soils and subsurface conditions similar to those encountered at this site. Because the test boring represents a very small statistical sampling of subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different from those indicated by the test boring. In these instances, adjustments to the design and construction may be necessary depending on actual conditions.

### Geotechnical Considerations

The following geotechnical characteristics of the site should be considered for planning and design:

- Fill materials were encountered in all borings extending to depths ranging from about 6 to 12 feet. Boring B-5 was terminated in fill materials at a depth of 15 feet. Standard penetration test resistances recorded in the fill suggest low to moderate and highly variable compactive effort at the time of fill placement.

- Based on the results of the test borings, fill materials and residual soils should be readily removable from within anticipated excavation depths. Partially weathered rock was encountered in borings B-2 and B-4 beginning at depths of about 27 and 37 feet, respectively. Boring B-2 encountered materials causing auger refusal at a depth of 35 feet.

- At the time of drilling, groundwater was encountered in borings B-3 and B-4 at a depth of 37 feet. For safety reasons, the boring was backfilled with soil cuttings upon completion and patched with asphalt or concrete where appropriate. Based on our understanding of the project, we do not expect groundwater to be a major hindrance during construction.

- It is our opinion that the proposed Effluent Water Pump station can be supported using a conventional reinforced concrete mat. The planned Thermal Dryer and Cake Handling facilities can be supported using a monolithic reinforced concrete mat foundation. However, the upper fill materials in the test borings contained rock fragments and were extremely variable. To reduce uncertainty regarding mat foundation settlement, we recommend excavating the mat footprint to a depth of 2 feet below the lowest planned bearing elevation and backfilling the excavation with GDOT compliant graded aggregate base (GAB). GAB should be compacted to at least 95 percent of the modified Proctor maximum dry density. The excavation should be evaluated prior backfilling with GAB. Depending on conditions, it may be necessary to extend the excavation to greater depth in select areas.

- Based on the loads provided to us, we recommend using an allowable bearing pressure of 2,500 psf for foundation design purposes. A modulus of subgrade reaction of 65 pci can be used for design of mat foundations. Column footings should have a minimum width of 24 inches and wall footings should be at least 18 inches wide to prevent general bearing capacity failure. Exterior foundations and turndown should bear at least 18 inches below the prevailing ground surface to avoid potential problems due to frost heave.

- Preparing the planned structures foundations will involve excavation beside existing structures. Care should be taken not to undermine the existing foundations during foundation excavation.

- Based on the results of the test borings and following the calculation procedure in the 2018 International Building Code (Chapter 20, ASCE 7-16), the seismic *Site Class* for the site is *D*. The mapped and design spectral response accelerations are as follows: $S_S$=0.229, $S_1$=0.091, $S_{DS}$=0.245, $S_{D1}$=0.146.

  On January 1, 2026, Georgia will transition to the 2024 version of IBC, which references ASCE 7-22 regrading many subjects including seismic design. Under the 2024 IBC (Chapter 20, ASCE 7-22) the seismic *Site Class* for the site is D based on estimated average shear wave velocity profiles derived from standard penetration test resistance correlations. The mapped and design spectral response accelerations under IBC 2024 (ASCE 7-22) are as follows: $S_S$=0.290, $S_1$=0.099, $S_{DS}$=0.230, $S_{D1}$=0.140.

The following sections provide recommendations regarding these issues and other geotechnical aspects of the project.

## Existing Fill Materials

Fill materials were encountered in all borings extending to depths ranging from about 6 to 12 feet. Boring B-5 was terminated in fill materials at a depth of 15 feet. Standard penetration test resistances recorded in the fill indicate low to moderate and highly variable compactive effort at the time of fill placement. There are several important facts that should be considered regarding existing fill materials and the limitations of subsurface exploration.

- The quality of existing fill materials can be highly variable, and test borings are often not able to detect all of the zones or layers of poor-quality fill materials.

- Layers of poor-quality fill materials that are less than about 2.5 to 5 feet thick may often remain undetected by soil test borings due to the discrete-interval sampling method used in this exploration.

- The interface between existing fill materials and the original ground surface may include a layer of organic material that was not properly stripped off during the original grading. Depending on its relationship to the foundation bearing surface, an organic layer might adversely affect foundation support. If such organic layers are encountered during construction, it may be necessary to "chase out" the organic layer by excavating the layer along with overlying soils.

- Subsurface exploration is simply not capable of disclosing all conditions that may require remediation.

## General Site Preparation

Pavement materials, landscaping, topsoil, grass, and any unrelated construction materials should be completely removed from within the construction area. Additionally, site clearing, grubbing, and stripping should be performed only during dry weather conditions. Operation of heavy equipment on the site during wet conditions could result in excessive mixing of topsoil and organic debris with underlying soils.

Site preparation for this project may involve rerouting existing underground utilities which may be located within the proposed foundation footprints. If such utility relocation is required, we recommend backfilling the resulting utility trenches up to the mat foundation bearing elevation using flowable fill or well-compacted graded aggregate base (GAB). Flowable fill is a product available from ready-mix plants that resembles very dense soil after curing. If GAB is used as backfill material, GAB must be compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D1557). Geo-Hydro should be on site to perform in-place density testing of GAB to verify proper compaction.

As a matter of design, the footprints of the mats supporting the Thermal Drying and Cake Handling buildings should be excavated to a depth of 2 feet below the mat or foundation bearing elevation. The resulting excavation should be backfilled with GDOT compliant graded aggregate base (GAB). GAB should be compacted to at least 95 percent of the modified Proctor maximum dry density. The excavation should be evaluated prior backfilling with GAB. Depending on conditions, it may be necessary to extend the excavations to greater depth in select areas.

During site preparation, burn pits or trash pits may be encountered. All too frequently such buried material occurs in isolated areas which are not detected by the soil test borings. Any buried waste, construction debris, trash, or abandoned utilities found during the construction operation should be thoroughly excavated, and the waste material should be removed from the site.

## Excavation Characteristics

The near-surface fill and residual soils at the site should be readily removable using conventional soil excavation equipment such as loaders, backhoes, etc. Partially weathered rock was encountered in borings B-2 and B-4 beginning at depths of about 27 and 37 feet, respectively. Boring B-2 encountered materials causing auger refusal at a depth of 35 feet. It is important to note that the depth to partially weathered rock or rock can very drastically over relatively short distances.

For construction bidding and field verification purposes it is common to provide a verifiable definition of rock in the project specifications. The following is the typical definition of trench rock:

- Trench Rock: Material occupying an original volume of at least one-half cubic yard which cannot be excavated with a hydraulic excavator having a minimum flywheel power rating of 123 kW (165 hp); such as a Caterpillar 322C L, John Deere 230C LC, or a Komatsu PC220LC-7; equipped with a short tip radius bucket not wider than 42 inches.

The foregoing definition is based on large equipment typically utilized for mass grading. Excavations for foundations and underground utilities are often performed with smaller equipment such as rubber-tired backhoe/loaders or even mini-excavators. When difficult excavation in denser materials is encountered, contractors will often request additional payment for mobilizing larger equipment than that which was anticipated during preparation of their construction bid. The amount of additional compensation, if any, and the minimum equipment size necessary to qualify for any additional compensation should be defined before the start of construction.

## Groundwater

At the time of drilling, groundwater was encountered in borings B-3 and B-4 at a depth of 37 feet. Although groundwater is not expected to be a hindrance for site preparation and foundation construction, we must point out that groundwater levels vary and may rise in the future. Regardless of the groundwater conditions encountered in the borings, waterproofing and subsurface drainage is required for all below grade structures.

## Reuse of Excavated Materials (Ancillary Grading and Backfill)

Based on the results of the test boring, the fill materials and residual soils at the project site appear suitable for reuse as structural fill material. Routine adjustment of moisture content will be necessary to allow proper placement and compaction.

It is important to establish as part of the construction contract whether soils having elevated moisture content will be considered suitable for reuse. We often find this issue to be a point of contention and a source of delays and change orders. From a technical standpoint, soils with moisture contents wet of optimum as determined by the standard Proctor test (ASTM D698) can be reused provided that the moisture is properly adjusted to within the workable range. From a practical standpoint, wet soils can be very difficult to dry during periods of extended wet weather and low temperatures. Such difficulties should be considered during planning and budgeting. A clear understanding by the contractor regarding the reuse of excavated soils will be important to avoid delays and unexpected cost overruns.

## Structural Fill (Ancillary Grading and Backfill)

We offer the following recommendations for any fill or backfill required outside the mat foundation or building footprints. *As described above, any excavations within the building or mat foundation footprints must be backfilled with well-compacted graded aggregate base (GAB).*

Materials selected for use as structural fill should be free of organic debris, waste construction debris, and other deleterious materials. The material should not contain rocks having a diameter over 4 inches. It is our opinion that the following soils represented by their USCS group symbols will typically be suitable for use as structural fill and are usually found in abundance in the Piedmont: (SM), (ML), and (CL). The following soil types are typically suitable but are not abundant in the Piedmont: (SW), (SP), (SC), (SP-SM), and (SP-SC). The following soil types are considered unsuitable: (MH), (CH), (OL), (OH), and (Pt).

Laboratory Proctor compaction tests and classification tests should be performed on representative samples obtained from the proposed borrow material to provide data necessary to determine acceptability and for quality control. The moisture content of suitable borrow soils should generally be no more than 3 percentage points below or above optimum at the time of compaction. Tighter moisture limits may be necessary with certain soils.

Suitable fill material should be placed in thin lifts. Lift thickness depends on the type of compaction equipment, but a maximum loose-lift thickness of 8 inches is generally recommended. The soil should be compacted by a self-propelled sheepsfoot roller. Within small excavations such as in utility trenches, around manholes, above foundations, or behind retaining walls, we recommend the use of "wacker packers" or "Rammax" compactors to achieve the specified compaction. Loose lift thicknesses of 4 to 6 inches are recommended in small area fills.

We recommend that structural fill be compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D698). The upper 12 inches of floor slab subgrade soils should be compacted to at least 98 percent of the standard Proctor maximum dry density. The upper 12 inches of pavement subgrades should be compacted in accordance with Georgia DOT requirements to at least 100 percent of the standard Proctor maximum dry density (ASTM D698). Additionally, the maximum dry density of structural fill should be no less than 90 pcf. Geo-Hydro should perform density tests during fill placement.

## Earth Slopes

Temporary construction slopes should be designed in strict compliance with OSHA regulations. The exploratory borings indicate that most soils at the site are Type e C as defined in 29 CFR 1926 Subpart P. This dictates that temporary construction slopes be no steeper than 1.5H:1V for excavation depths of 20 feet or less. Temporary construction slopes should be closely observed on a daily basis by the contractor's "competent person" for signs of mass movement: tension cracks near the crest, bulging at the toe of the slope, etc. The responsibility for excavation safety and stability of construction slopes should lie solely with the contractor.

We recommend that extreme caution be observed in trench excavations. Several cases of loss of life due to trench collapses in Georgia point out the lack of attention given to excavation safety on some projects. We recommend that applicable local and federal regulations regarding temporary slopes, and shoring and bracing of trench excavations be closely followed.

Formal analysis of slope stability was beyond the scope of work for this project. Based on our experience, permanent cut or fill slopes should be no steeper than 2H:1V to maintain long term stability and to provide ease of maintenance. The crest or toe of cut or fill slopes should be no closer than 10 feet to any foundation. The crest or toe should be no closer than 5 feet to the edge of any pavements. Erosion protection of slopes during construction and during establishment of vegetation should be considered an essential part of construction.

## Earth Pressure (Cast-In-Place Structures)

Three earth pressure conditions are generally considered for retaining wall design: "at rest", "active", and "passive" stress conditions. Retaining walls which are rigidly restrained at the top and will essentially be unable to rotate under the action of earth pressure (such loading dock walls) should be designed for "at rest" conditions. Retaining walls which can move outward at the top as much as 0.5 percent of the wall height (such as free-standing walls) should be designed for "active" conditions. For the evaluation of the resistance of soil to lateral loads the "passive" earth pressure must be calculated. It should be noted that full development of passive pressure requires deflections toward the soil mass on the order of 1.0 percent to 4.0 percent of total wall height.

Earth pressure may be evaluated using the following equation:

$$p_h = K (D_w Z + q_s) + W_w(Z-d)$$

where: $p_h$ = horizontal earth pressure at any depth below the ground surface (Z).
$W_w$ = unit weight of water
Z = depth to any point below the ground surface
d = depth to groundwater surface
$D_w$ = wet unit weight of the soil backfill (depending on borrow sources). The wet unit weight of most residual soils may be expected to range from approximately 115 to 125 pcf. Below the groundwater level, $D_w$ must be the buoyant weight.
$q_s$ = uniform surcharge load (add equivalent uniform surcharge to account for construction equipment loads)
K = earth pressure coefficient as follows:

| Earth Pressure Condition | Coefficient |
|---|---|
| At Rest ($K_o$) | 0.53 |
| Active ($K_a$) | 0.36 |
| Passive ($K_p$) | 2.8 |

The groundwater term, $W_w(Z-d)$, should be used if no drainage system is incorporated behind retaining walls. If a drainage system is included which will not allow the development of any water pressure behind the wall, then the groundwater term may be omitted. The development of excessive water pressure is a common cause of retaining wall failures. Drainage systems should be carefully designed to ensure that long term permanent drainage is accomplished.

The above design recommendations are based on the following assumptions:

- Horizontal backfill
- 95 percent standard Proctor compactive effort on backfill (ASTM D698)
- No safety factor is included

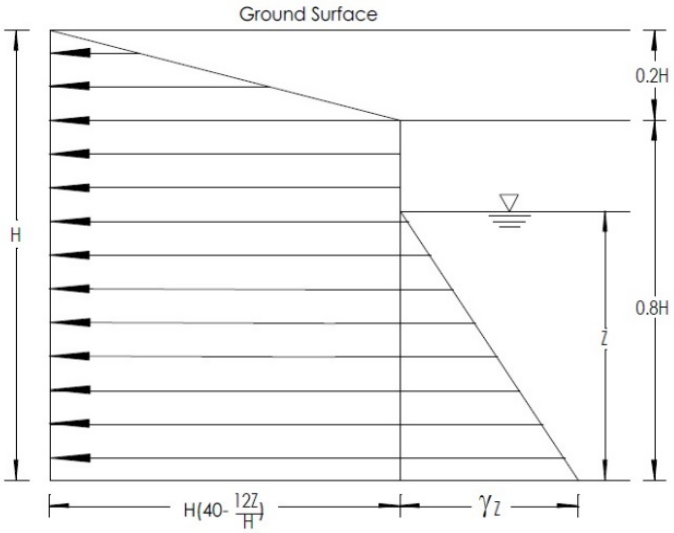
For convenience, equivalent fluid densities are frequently used for the calculation of lateral earth pressures. For "at rest" stress conditions, an equivalent fluid density of 66 pcf may be used. For the "active" state of stress an equivalent fluid density of 45 pcf may be used. These equivalent fluid densities are based on the assumptions that drainage behind the retaining wall will allow *no* development of hydrostatic pressure; that native sandy silts or silty sands will be used as backfill; that the backfill soils will be compacted to at least 95 percent of standard Proctor maximum dry density; that backfill will be horizontal; and that no surcharge loads will be applied.

For analysis of sliding resistance of the base of a cast-in-place concrete retaining wall, the coefficient of friction may be taken as 0.4 for the soils at the project site. This is an ultimate value, and an adequate factor of safety should be used in design. Customarily, retaining wall design includes a factor of safety which affects the global design. Using that design approach, it is not necessary to reduce the coefficient of friction as a design input. Such a reduction would place an unreasonable reduction in the calculation of the frictional resistance.

The force which resists base sliding is calculated by multiplying the normal force on the base by the coefficient of friction. Full development of the frictional force could require deflection of the base of roughly 0.1 to 0.3 inches.

## Earth Pressure – Small Below-Grade Structures

Based on our experience, the lateral earth pressure distribution for the walls of relatively small and rigid below-grade structures, such as vaults, wets wells, etc., can be approximated by a braced wall configuration. The walls of these structures may be designed for the pressure distribution shown on following diagram:




Where: H = Total depth of wall below the ground surface, feet
Z = Height of groundwater level above the bottom of the wall, feet
γ = Unit weight of water (62.4 pcf)
pressure units are psf

## Mat Foundation Preparation

It is our opinion that the Thermal Dryer and Cake Handling facilities can be supported using monolithic reinforced concrete mat foundations. However, the upper fill materials in the test borings contained rock fragments and were extremely variable. To reduce uncertainty regarding mat foundation settlement, we recommend excavating the mat or building footprint to a depth of 2 feet below bearing elevation and backfilling the excavation with GDOT compliant graded aggregate base (GAB). GAB should be compacted to at least 95 percent of the modified Proctor maximum dry density. The excavation should be evaluated prior backfilling with GAB. Depending on conditions, it may be necessary to extend the excavation to greater depth in select areas.

## Foundation Design

It is our opinion that the proposed Effluent Water Pump station can be supported using a conventional reinforced concrete mat, and the Thermal Dryer and Cake Handling facilities can be supported using reinforced concrete structural mats with turndowns. Thorough evaluation of foundation and structural mat excavations will be necessary to identify any localized areas of loose or soft soils within bearing subgrades. Soft or weak soils at bearing elevation should be excavated and replaced with well-compacted graded aggregate base or with concrete.

Based on the mat foundation loads provided to us, we recommend using an allowable bearing pressure of 2,500 psf for foundation design purposes. A modulus of subgrade reaction of 65 pci can be used for design of mat foundations. Column footings should have a minimum width of 24 inches and wall footings should be at least 18 inches wide to prevent general bearing capacity failure. Exterior foundations and turndown should bear at least 18 inches below the prevailing ground surface to avoid potential problems due to frost heave.

Increasing the allowable bearing pressure by one-third is allowed for certain transient load combinations as outlined in the 2018 International Building Code (see sections 1605.3.2 and 1806.1 of IBC 2018). We estimate that under gravity loading conditions, total settlement of mat foundations or individual foundations will be less than 1 inch, with possibly as much as ½ inch of planar tilt or differential settlement.

Within the Thermal Dryer and Cake Handling footprints, the upper fill materials in the test borings contained rock fragments and were highly variable. To reduce uncertainty regarding mat foundation settlement, we recommend excavating the mat footprint to a depth of 2 feet below the lowest planned bearing elevation and backfilling the excavation with GDOT compliant graded aggregate base (GAB). GAB should be compacted to at least 95 percent of the modified Proctor maximum dry density.

The actual depth and configuration of remedial excavation will be dictated by conditions at the time of construction. The depth and volume of remedial excavation and replacement may exceed the suggested budgetary estimate to prepare the Thermal Dryer and Cake Handling footprints.

Improving subgrade conditions in mat foundation excavations such as that required for the Effluent Pump Station is generally limited to removing soft soils from the mat area and replacing the soft soils with crushed

stone materials, flowable fill, or concrete. The choice of backfill material will depend on construction logistics and desired expediency. If GAB is used, the material should be compacted to at least 95 percent of the modified Proctor maximum dry density.

For mat foundations it is customary to place an open-graded stone course on the prepared soil subgrade to provide a uniform, "clean" working surface and to preserve the underlying subgrade. For the Effluent Pump Station, we suggest a 6- to 12-inch-thick course of #57 stone located immediately beneath reinforced concrete mat.

## Lateral Load Resistance

Resistance to lateral loads is developed by the passive resistance of the soil against the mat foundation and by the friction force or sliding resistance between the concrete mat and the bearing material.

For analysis of sliding resistance, we recommend a coefficient of friction of 0.4 between mass concrete and anticipated bearing materials. This is an ultimate value, and an adequate factor of safety should be used in design. The force which resists sliding is calculated by multiplying the normal force on the base by the coefficient of friction. Full development of the frictional force could require deflection of the base of roughly 0.1 to 0.3 inches.

An allowable lateral earth pressure of 130 psf per foot of depth can be used for passive earth pressure resistance. It should be noted that full development of passive pressure will require deflection toward the soil mass on the order of ½-inch.

## Seismic Design

Based on the results of the test borings and following the calculation procedure in the 2018 International Building Code (Chapter 20, ASCE 7-16), the seismic *Site Class* for the site is *D.* The mapped and design spectral response accelerations are as follows: $S_S$=0.229, $S_1$=0.091, $S_{DS}$=0.245, $S_{D1}$=0.146.

On January 1, 2026, Georgia will transition to the 2024 version of IBC, which references ASCE 7-22 regrading many subjects including seismic design. Under the 2024 IBC (Chapter 20, ASCE 7-22) the seismic *Site Class* for the site is D based on estimated average shear wave velocity profiles derived from standard penetration test resistance correlations. The mapped and design spectral response accelerations under IBC 2024 (ASCE 7-22) are as follows: $S_S$=0.290, $S_1$=0.099, $S_{DS}$=0.230, $S_{D1}$=0.140.

Based on the information obtained from the soil test boring, it is our opinion that the potential for liquefaction of the residual soils at the site due to earthquake activity is relatively low.

* * * * * * *

We appreciate the opportunity to serve as your geotechnical consultant for this project, and are prepared to provide any additional services you may require. If you have any questions concerning this report or any of our services, please call us.

Sincerely,

GEO-HYDRO ENGINEERS, INC.

Jacob O. Congrove, E.I.T.
Staff Engineer
*jcongrove@geohydro.com*

Luis E. Babler, P.E.
Chief Engineer
*luis@geohydro.com*

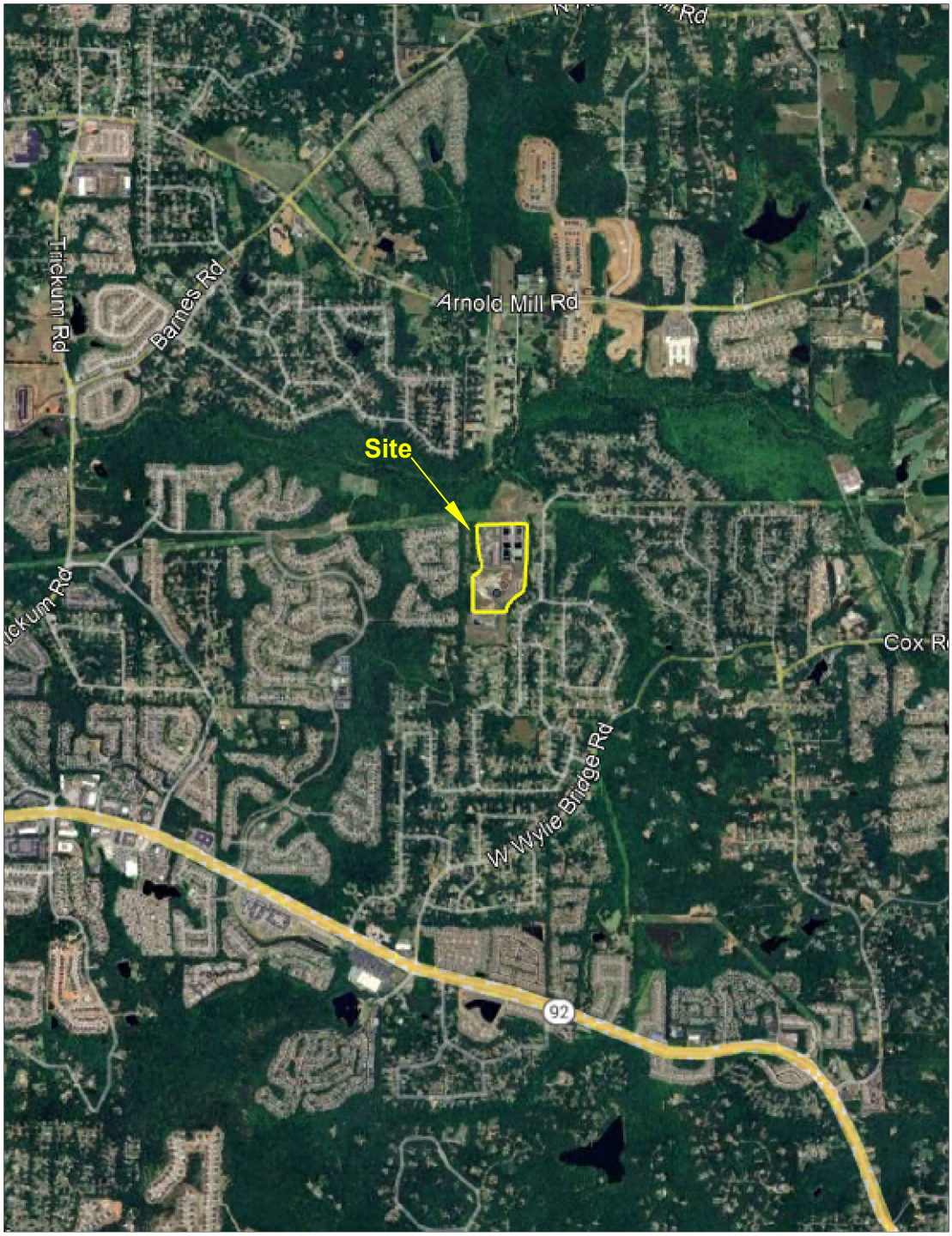
GEORGIA REGISTERED No. 021308 PROFESSIONAL ENGINEER LUIS E. BABLER

JOC/LEB/251796.20 - Fitzgerald Creek Thermal Dryer Facility - Report leb.docx



GEO HYDRO ENGINEERS

# APPENDIX

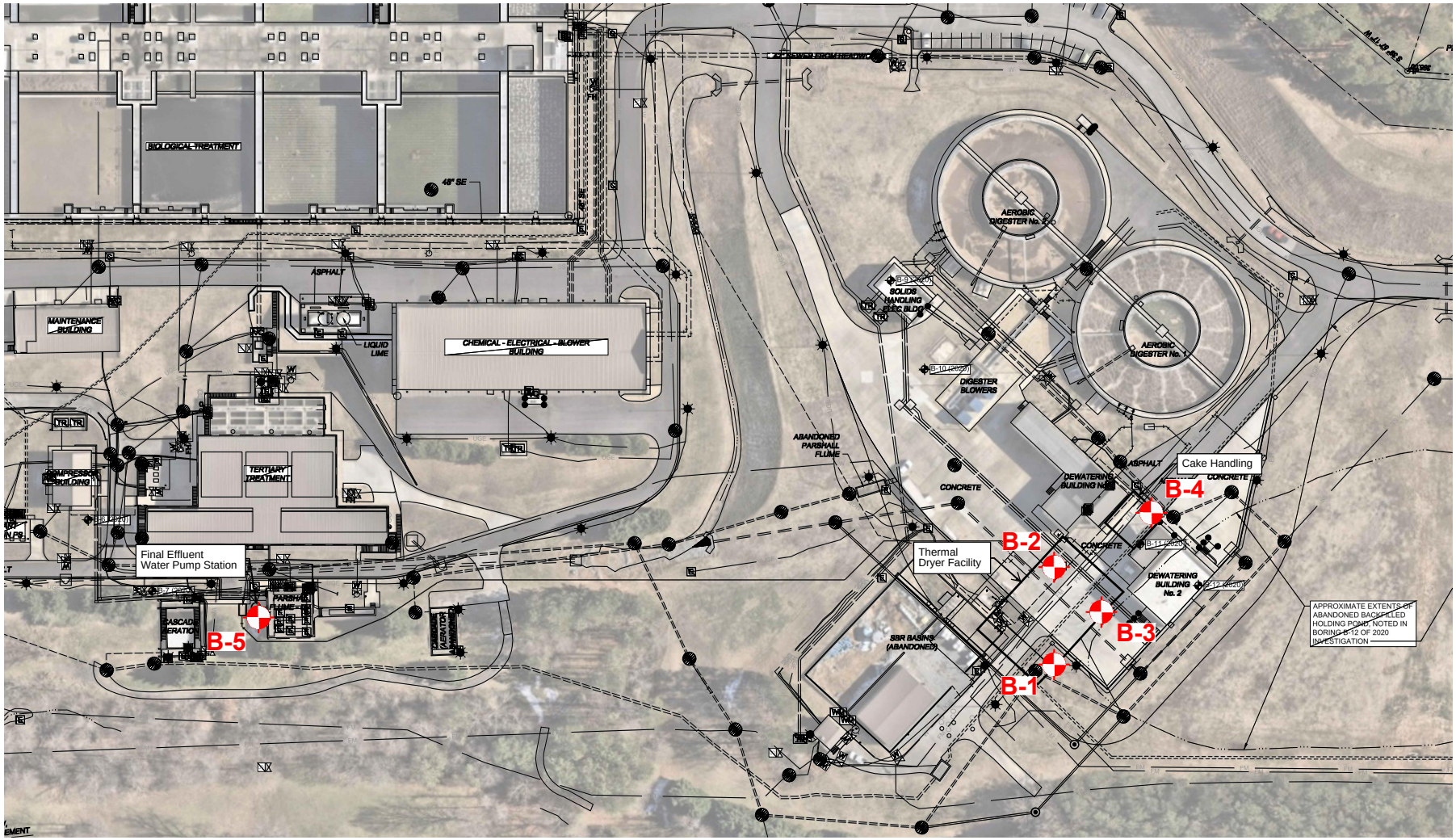



0 0.25 0.5 1 1.5

Approximate Scale, Miles

Figure 1: Site Location Plan

Fitzgerald Creek Thermal Dryer Facility
Cherokee County Water & Sewage Authority
Woodstock, Georgia
Geo-Hydro Project Number 251796.20




0 70 140 280 420

Approximate Scale: 1"=140'

LEGEND: Soil Test Boring

Figure 2: Boring Location Plan

Fitzgerald Creek Thermal Dryer Facility
Cherokee County Water & Sewage Authority
Woodstock, Georgia
Geo-Hydro Project Number 251796.20

# Symbols and Nomenclature

## Symbols

| | |
|---|---|
| ▌ | Thin-walled tube (TWT) sample recovered |
| ▯ | Thin-walled tube (TWT) sample not recovered |
| ● | Standard penetration resistance (ASTM D1586) |
| 50/2” | Number of blows (50) to drive the split-spoon a number of inches (2) |
| 65% | Percentage of rock core recovered |
| RQD | Rock quality designation - % of recovered core sample which is 4 or more inches long |
| GW | Groundwater |
| ▼ | Water level at least 24 hours after drilling |
| ▽ | Water level one hour or less after drilling |
| ALLUV | Alluvium |
| TOP | Topsoil |
| PM | Pavement Materials |
| CONC | Concrete |
| FILL | Fill Material |
| RES | Residual Soil |
| PWR | Partially Weathered Rock |
| SPT | Standard Penetration Testing |

**Penetration Resistance Results**

| | Number of Blows, N | Approximate Relative Density |
|---|---|---|
| Sands | 0-4 | very loose |
| | 5-10 | loose |
| | 11-20 | firm |
| | 21-30 | very firm |
| | 31-50 | dense |
| | Over 50 | very dense |

| | Number of Blows, N | Approximate Consistency |
|---|---|---|
| Silts and Clays | 0-1 | very soft |
| | 2-4 | soft |
| | 5-8 | firm |
| | 9-15 | stiff |
| | 16-30 | very stiff |
| | 31-50 | hard |
| | Over 50 | very hard |

## Drilling Procedures

Soil sampling and standard penetration testing performed in accordance with ASTM D 1586. The standard penetration resistance is the number of blows of a 140-pound hammer falling 30 inches to drive a 2-inch O.D., 1.4-inch I.D. split-spoon sampler one foot. Rock coring is performed in accordance with ASTM D 2113. Thin-walled tube sampling is performed in accordance with ASTM D 1587.

# B-1

## Test Boring Record

GEO HYDRO ENGINEERS

| | | |
|---|---|---|
| Project: **Fitzgerald Creek Thermal Dryer Facility** | | Project No: **251796.20** |
| Location: **Cherokee County, Georgia** | | Date: **7/8/25** |
| Method: **HSA- ASTM D1586** | GWT at Drilling: **Not Encountered** | G.S. Elev: **966** |
| Driller: **GCD (Auto-Hammer)** | GWT at 24 hrs: **N/A (Boring Backfilled)** | Logged By: **ST** |

| Elev. (Ft) | Depth (Ft) | Description | N |
|---|---|---|---|
| 965 | 0 | Topsoil (Approximately 3 inches) | |
| | | Very loose to loose red-brown clayey fine to coarse sand (SC) with rock fragments (FILL) | 3 |
| | 5 | | 5 |
| 960 | | | 3 |
| | 10 | | 4 |
| 955 | | Firm tan and white silty fine sand (SM) with rock fragments (SM) (FILL) | |
| | 15 | | 11 |
| 950 | | Red-brown fine sandy clay (CL) with rock fragments (FILL) ** | |
| | 20 | | 27 |
| 945 | | Loose tan, brown, and white silty fine sand (SM) (RESIDUUM) | |
| | 25 | | 10 |
| 940 | | | |
| | 30 | | 9 |
| 935 | | Firm to very firm brown to orange and tan silty fine sand (SM) | |
| | 35 | | 29 |
| 930 | | | |
| | 40 | | 17 |
| 925 | | Boring Terminated at 40 feet | |
| | 45 | | |

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

**Remarks:** ** Standard penetration test resistance not considered representative due to rock fragments in the fill

TEST BORING RECORD BORING LOGS.GPJ GEO HYDRO.GDT 7/27/25

# B-2

## Test Boring Record

GEO HYDRO ENGINEERS

| | | |
|---|---|---|
| Project: **Fitzgerald Creek Thermal Dryer Facility** | | Project No: **251796.20** |
| Location: **Cherokee County, Georgia** | | Date: **7/8/25** |
| Method: **HSA- ASTM D1586** | GWT at Drilling: **Not Encountered** | G.S. Elev: **968** |
| Driller: **GCD (Auto-Hammer)** | GWT at 24 hrs: **N/A (Boring Backfilled)** | Logged By: **ST** |

| Elev. (Ft) | Depth (Ft) | GWT | Symbol | Description | N |
|---|---|---|---|---|---|
| | 0 | | | Concrete (Approximately 6 inches) | |
| 965 | | | | Loose brown silty fine to coarse sand (SM) with rock fragments (FILL) | 6 |
| | 5 | | | | 8 |
| 960 | | | | Loose brown and red clayey fine to coarse sand (SC) with rock fragments (FILL) | 9 |
| | 10 | | | | 9 |
| 955 | | | | Loose to firm tan and white slightly micaceous silty fine to coarse sand (SM) (RESIDUUM) | |
| | 15 | | | | 9 |
| 950 | | | | | |
| | 20 | | | | 18 |
| 945 | | | | | |
| | 25 | | | | 13 |
| 940 | | | | Partially weathered rock sampled as tan slightly micaceous silty fine sand (SM) | |
| | 30 | | | | 50/2" |
| 935 | | | | | |
| | 35 | | | Auger Refusal at 35 feet | 50/1" |
| 930 | | | | | |
| | 40 | | | | |
| 925 | | | | | |
| | 45 | | | | |

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

**Remarks:**

TEST BORING RECORD BORING LOGS.GPJ GEO HYDRO.GDT 7/27/25

# B-3

## Test Boring Record

GEO HYDRO ENGINEERS

| | | |
|---|---|---|
| Project: **Fitzgerald Creek Thermal Dryer Facility** | | Project No: **251796.20** |
| Location: **Cherokee County, Georgia** | | Date: **7/8/25** |
| Method: **HSA- ASTM D1586** | GWT at Drilling: **37 feet** | G.S. Elev: **967** |
| Driller: **GCD (Auto-Hammer)** | GWT at 24 hrs: **N/A (Boring Backfilled)** | Logged By: **ST** |

| Elev. (Ft) | Depth (Ft) | Description | N |
|---|---|---|---|
| 965 | 0 | Concrete (Approximately 6 inches) | |
| | | Loose gray to brown clayey fine to coarse sand (SC) (FILL) | 7 |
| | 5 | | 8 |
| 960 | | Firm red slightly micaceous clayey fine sand (SC) (RESIDUUM) | 13 |
| | 10 | | 18 |
| 955 | | Loose to firm tan and orange to brown slightly micaceous silty fine sand (SM) | |
| | 15 | | 17 |
| 950 | | | |
| | 20 | | 15 |
| 945 | | | |
| | 25 | | 10 |
| 940 | | | |
| | 30 | | 8 |
| 935 | | Dense brown and orange silty fine sand (SM) | |
| | 35 | | 34 |
| 930 | | Firm orange, tan, and white silty fine sand (SM) with rock fragments | |
| | 40 | Boring Terminated at 40 feet | 18 |
| 925 | | | |
| | 45 | | |

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

**Remarks:**

TEST BORING RECORD BORING LOGS.GPJ GEO HYDRO.GDT 7/27/25

# B-4

## Test Boring Record

GEO HYDRO ENGINEERS

| | | |
|---|---|---|
| Project: **Fitzgerald Creek Thermal Dryer Facility** | | Project No: **251796.20** |
| Location: **Cherokee County, Georgia** | | Date: **7/8/25** |
| Method: **HSA- ASTM D1586** | GWT at Drilling: **37 feet** | G.S. Elev: **969** |
| Driller: **GCD (Auto-Hammer)** | GWT at 24 hrs: **N/A (Boring Backfilled)** | Logged By: **ST** |

| Elev. (Ft) | Depth (Ft) | GWT | Symbol | Description | N |
|---|---|---|---|---|---|
| | | | | Asphalt (Approximately 5 inches) | |
| | | | | Graded Aggregate Base (Approximately 12 inches) | 7 |
| 965 | 5 | | | Loose gray and red clayey fine to coarse sand (SC) with rock fragments (FILL) | 8 |
| | | | | Firm to stiff red-brown fine to coarse sandy clay (CL) (FILL) | 12 |
| 960 | 10 | | | Firm red slightly micaceous clayey fine sand (SC) (RESIDUUM) | 16 |
| | | | | Firm to very firm orange, tan, and brown slightly micaceous silty fine sand (SM) | |
| 955 | 15 | | | | 19 |
| 950 | 20 | | | | 25 |
| 945 | 25 | | | | 15 |
| 940 | 30 | | | | 17 |
| 935 | 35 | ▽ | | | 23 |
| 930 | 40 | | | Partially weathered rock sampled as gray, tan, and white slightly micaceous silty fine sand (SM) | 50/2" |
| | | | | Boring Terminated at 40 feet | |
| 925 | 45 | | | | |

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

**Remarks:**

TEST BORING RECORD BORING LOGS.GPJ GEO HYDRO.GDT 7/27/25

# B-5

## Test Boring Record

GEO HYDRO ENGINEERS

| | | |
|---|---|---|
| Project: **Fitzgerald Creek Thermal Dryer Facility** | | Project No: **251796.20** |
| Location: **Cherokee County, Georgia** | | Date: **7/8/25** |
| Method: **HSA- ASTM D1586** | GWT at Drilling: **Not Encountered** | G.S. Elev: **919** |
| Driller: **GCD (Auto-Hammer)** | GWT at 24 hrs: **N/A (Boring Backfilled)** | Logged By: **ST** |

| Elev. (Ft) | Depth (Ft) | GWT | Symbol | Description | N |
|---|---|---|---|---|---|
| | | | | Topsoil (Approximately 3 inches) | |
| 915 | 5 | | | Firm to very firm brown silty fine to coarse sand (SM) with rock fragments (FILL) | 13 |
| | | | | | 23 |
| | | | | No sample recovered at 7.5 feet (FILL) ** | 50/3" |
| 910 | 10 | | | Firm brown, red, and gray clayey fine to coarse sand (SC) (FILL) | 14 |
| 905 | 15 | | | Stiff tan fine sandy clay (CL) (FILL) | 15 |
| | | | | Boring Terminated at 15 feet | |
| 900 | 20 | | | | |
| 895 | 25 | | | | |
| 890 | 30 | | | | |
| 885 | 35 | | | | |
| 880 | 40 | | | | |
| 875 | 45 | | | | |

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

**Remarks:** ** Standard penetration test resistance not considered representative due to rock fragments in the fill

TEST BORING RECORD BORING LOGS.GPJ GEO HYDRO.GDT 7/27/25

# APPENDIX B

# Existing Record Drawings for Select Items/Structures to be Demolished/Removed (Information of Record)

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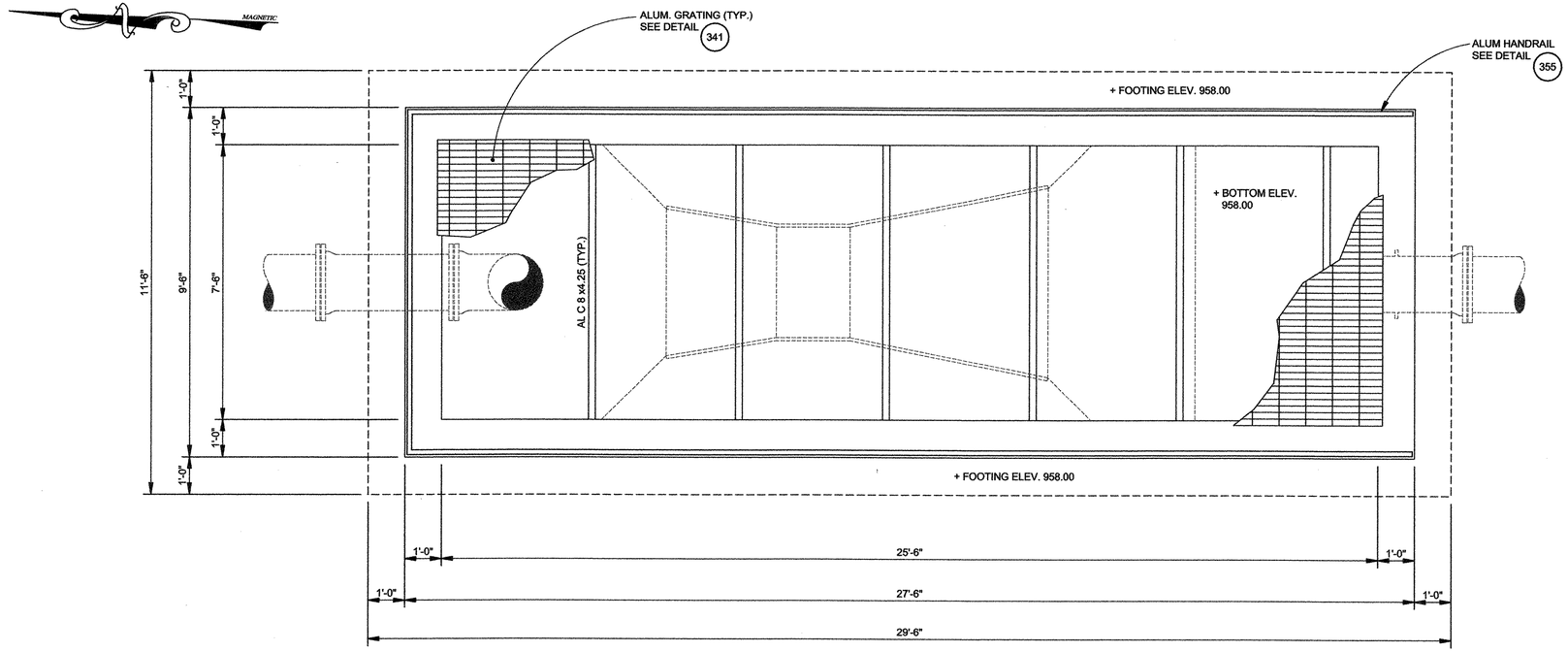


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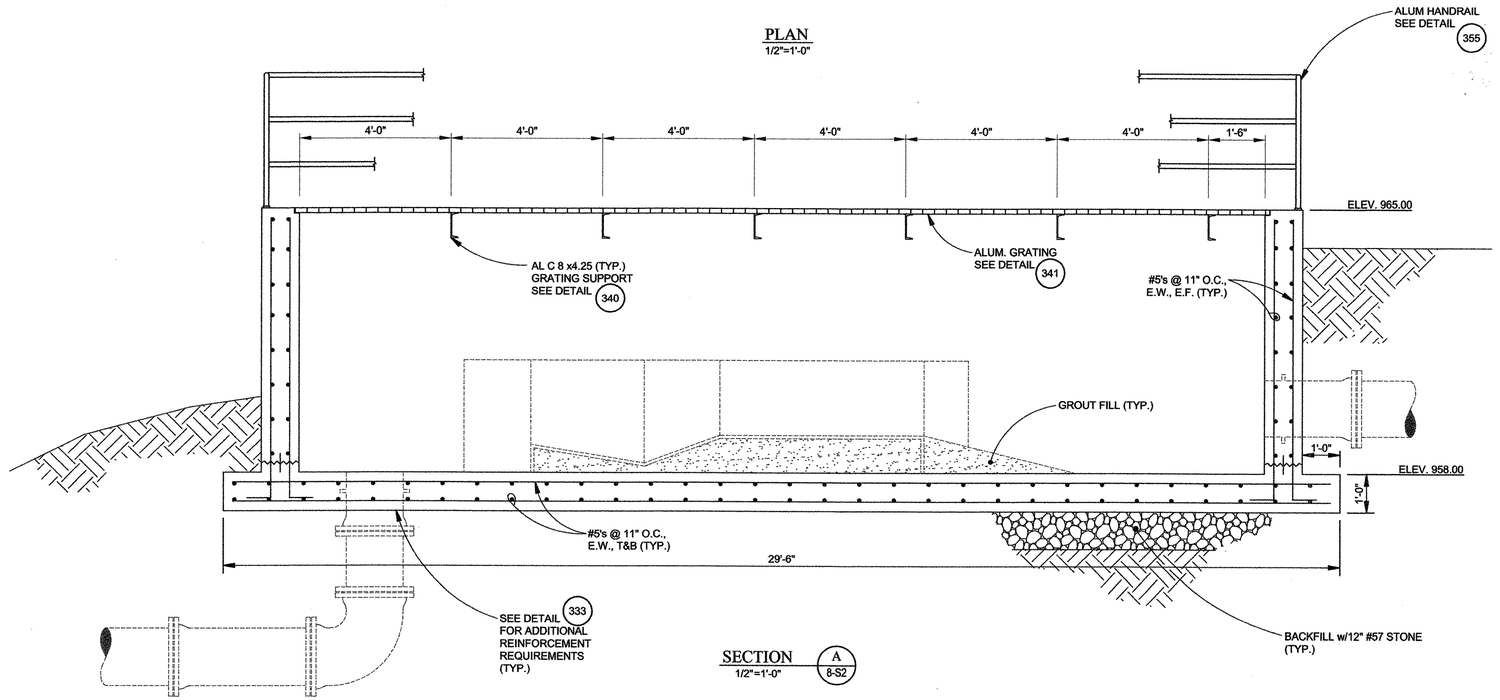


SECTION A
1/2"=1'-0" 8-S2

## RECORD DRAWING

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.


GEORGIA REGISTERED No. 24465 PROFESSIONAL ENGINEER DAVID R. HATABLIAN

WELKER & ASSOCIATES
A Division of PBS&J
445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316


| | DATE |
|---|---|
| REVISION | |
| △ | |

PROJ. NO: 732542.00
DESIGNED BY: D.R.H.
DRAWN BY: P.W.M.
CHECKED BY:
APPROVED BY: D.R.H.
DATE: APRIL 2005
SCALE: 1/2"=1'-0"

CHEROKEE COUNTY WATER & SEWER AUTHORITY
FITZGERALD CREEK EXPANSION TO 2.0 MGD

# PARSHALL FLUME
# PLAN AND SECTION

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8-S4
732542.00

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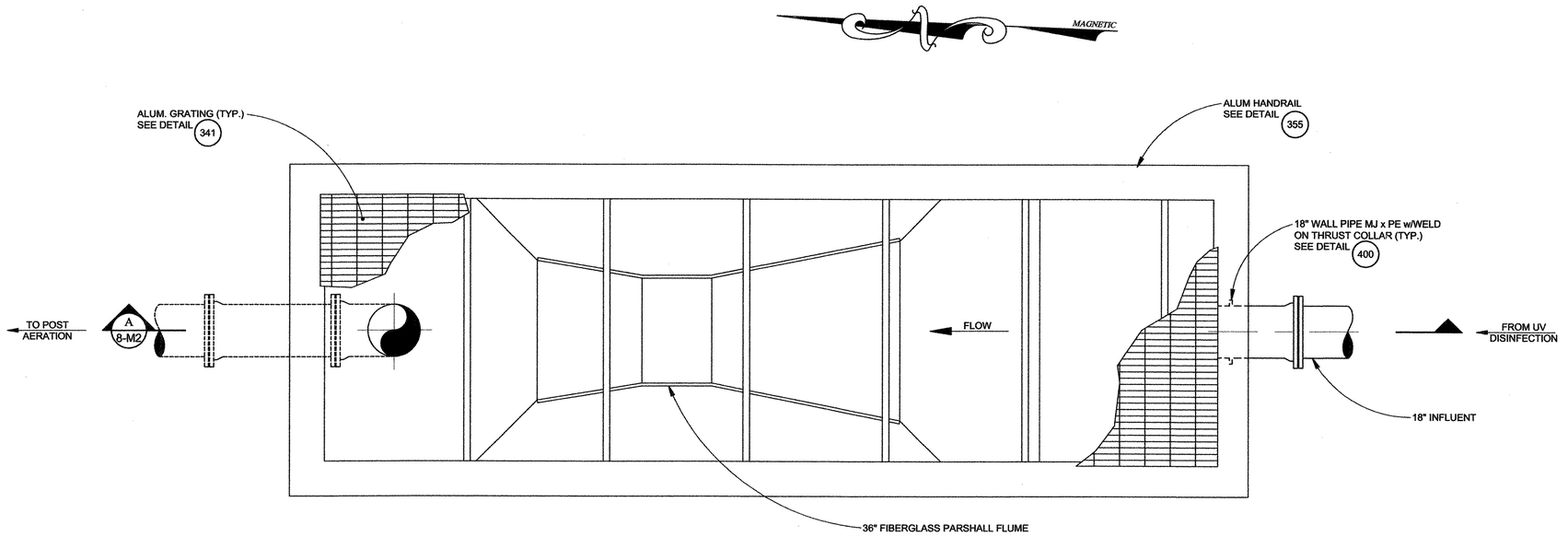


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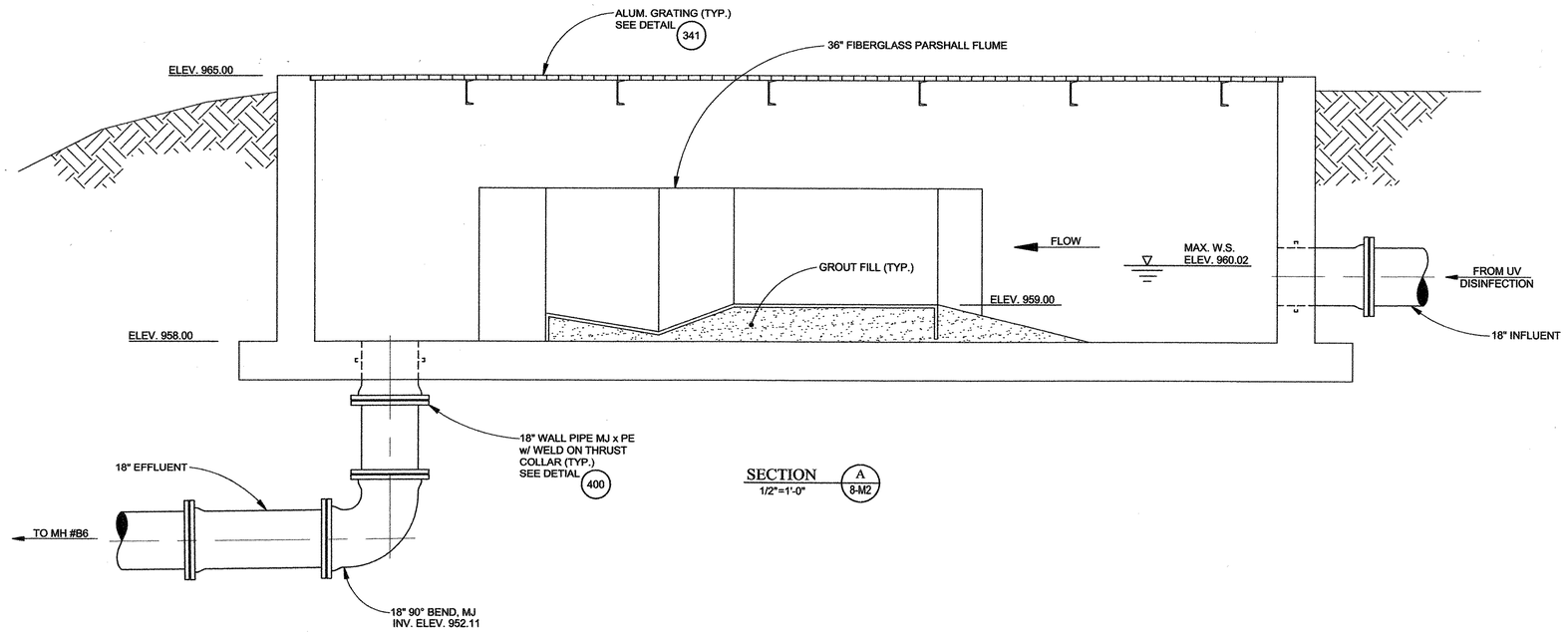
1/2"=1'-0"




SECTION A
1/2"=1'-0"
8-M2

## RECORD DRAWING

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GEORGIA REGISTERED No. 24681 PROFESSIONAL ENGINEER DAVID R. HATABIAN 6-22-05

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445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316

| | DATE |
|---|---|
| REVISION | |

PROJ. NO: 732542.00
DESIGNED BY: D.R.H.
DRAWN BY: P.W.M.
CHECKED BY: D.R.H.
APPROVED BY: D.R.H.
DATE: APRIL 2005
SCALE: 1/2"=1'-0"

CHEROKEE COUNTY WATER & SEWER AUTHORITY
FITZGERALD CREEK EXPANSION TO 2.0 MGD

# PARSHALL FLUME PLAN AND SECTION

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732542.00

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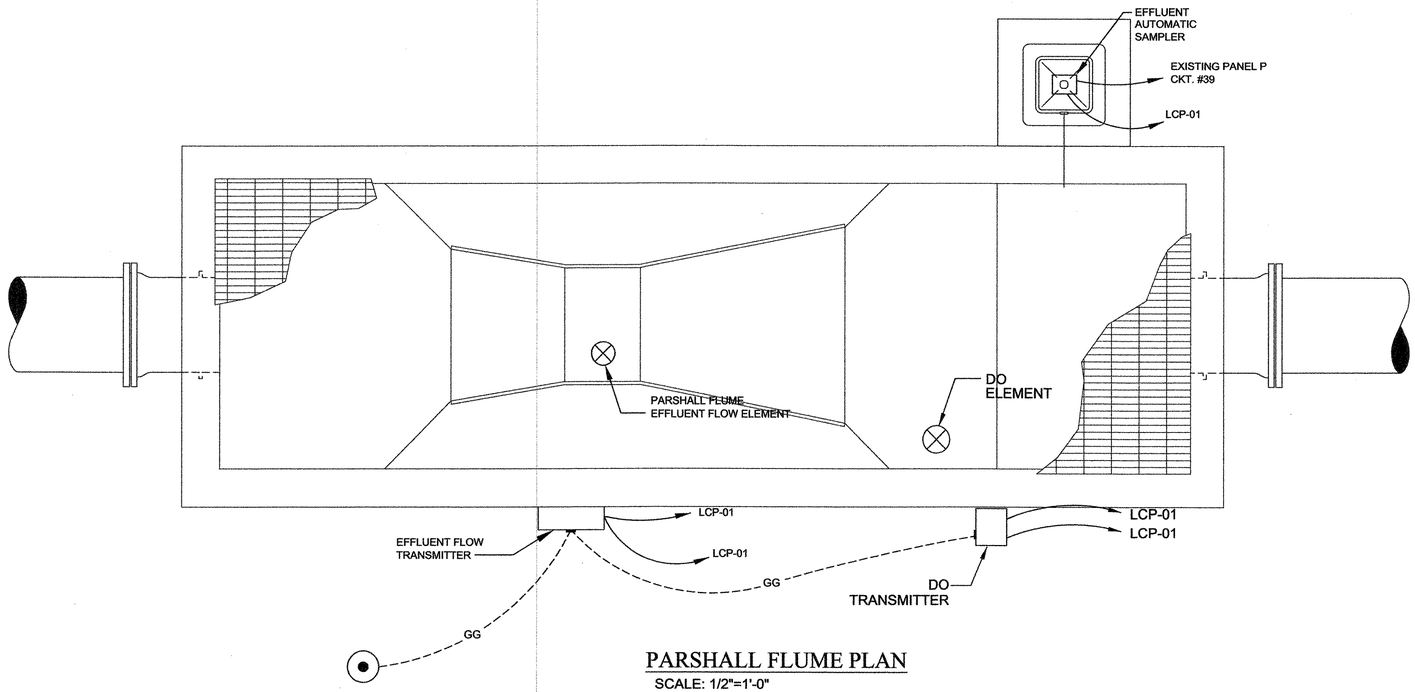
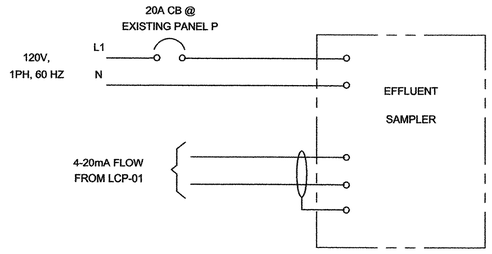



## PARSHALL FLUME PLAN

SCALE: 1/2"=1'-0"

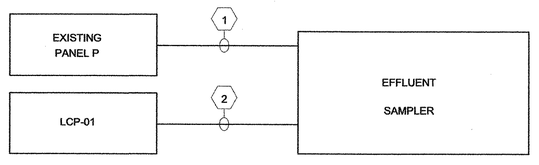
NOTES:

1. ALL JUNCTION BOXES LOCATED IN PARSHALL FLUME AREA SHALL BE NEMA 4X.



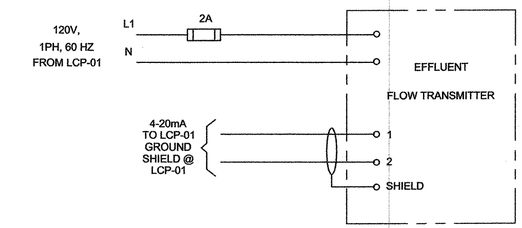

## EFFLUENT SAMPLER

SCHEMATIC DIAGRAM



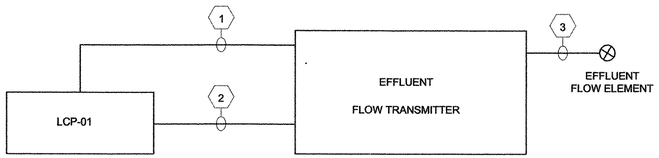

## EFFLUENT SAMPLER

RISER DIAGRAM




## PARSHALL FLUME

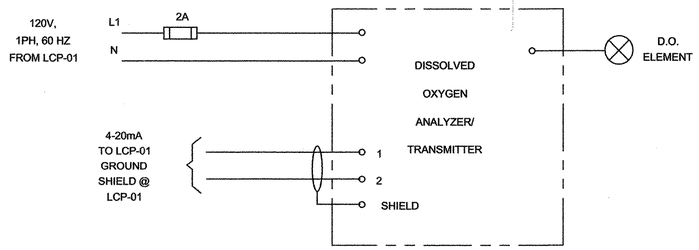
SCHEMATIC DIAGRAM




## PRASHALL FLUME

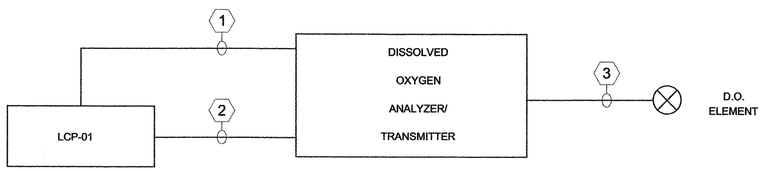
RISER DIAGRAM

| CABLE/CONDUIT SCHEDULE | |
|---|---|
| 1 | 2 #10 & 1 #10 GND IN 1" C. |
| 2 | 1 - #16 TWISTED SHIELDED PAIR IN 1" GRS C. |
| 3 | 1" C. (CABLE BY VENDOR) |




## DISSOLVED OXYGEN

SCHEMATIC DIAGRAM




## DISSOLVED OXYGEN

RISER DIAGRAM

## RECORD DRAWING

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.


Ray Group Consulting Engineers, Inc.
1827 Powers Ferry Road
Building 21, Suite 200
Atlanta, Georgia 30339
Tel. (770) 953-1443
Fax (770) 953-9533


GEORGIA REGISTERED No. 13677 PROFESSIONAL ENGINEER ASHIM K. RAY 06-22-05


WELKER & ASSOCIATES
A Division of PBSJ
445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316


| REVISION | DATE |
|---|---|
| | |

| | |
|---|---|
| PROJ. NO: | 732542.00 |
| DESIGNED BY: | DMZ. |
| DRAWN BY: | AK. |
| CHECKED BY: | DMZ |
| APPROVED BY: | AKR |
| DATE: | APRIL 2005 |
| SCALE: | 1/2"=1'-0" |

CHEROKEE COUNTY WATER & SEWER AUTHORITY
FITZGERALD CREEK EXPANSION TO 2.0 MGD

# PARSHALL FLUME PLAN

SHEET NO.

8-E1

732542.00

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18" EFFLUENT
PARSHALL FLUME
8" 90° BEND, MJ
8" WAS
8" 90° BEND, MJ
POLYMER FEED
EX. S.B.R.
EX. CONTROL BUILDING
SEE SHEET 7-M2 FOR EX. CONTROL BLDG. PIPING CONNECTIONS
SLUDGE THICKENER
1 1/2" WATER
1" POTABLE WATER
CONNECT TO EX. WATERLINE
EX. S.B.R.
F.H. (SEE DETAIL ON SHEET CD-7)
8'
6" SLUDGE LINE w/6" PLUG
1-6" TEE
1-6" G.V. w/BLIND FLANGE
6" POTABLE WATER
24" RWW FORCE MAIN
10" RWW FORCE MAIN
CONNECT TO EXISTING 4" PVC FORCE MAIN
4" RECYCLE FORCE MAIN
10" 45° BEND, MJ
24" 45° BEND, MJ
24" 45° BEND, MJ
10" DIP TO REJECT POND
PROPOSED 6' HIGH FENCE
INFLUENT METER VAULT
ABANDONDED IN PLACE
EX 6' HIGH FENCE
EX. RECYCLE PUMP STATION
REJECT POND

## YARD PIPING PLAN 'A'
SCALE: 1" = 20'

0' 10' 20' 40' 60'
GRAPHIC SCALE
Scale: 1 Inch = 20 Ft.

PACKAGE PLANT No. 2
1-18" 90° BEND, FL
2-18" 90° BEND, MJ
LIME FEED BUILDING
4" DRAIN
18" SECONDARY EFFLUENT
PULL BOX (TYP.)
2" POTABLE WATER
MH #D1
12" 22 1/2° BEND, MJ
WAS VALVE VAULT
LIME FEED
6" 45° BEND, MJ
6" WAS
1-12" 90° BEND, FL
1-12" 45° BEND, MJ
12" 45°, MJ
FILTERS
FILTERS
18" TEE, MJ
10" 45° BEND, MJ
24" 45° BEND, MJ
24" RWW FORCEMAIN
10" RWW FORCEMAIN
8" RECYCLE FORCEMAIN
8" 45° BEND, MJ
8" 90° BEND, MJ
SEE SHEET 2-M1 FOR FILTER YARD PIPING
2-12" 90° BEND, FL
2-12" 90° BEND, MJ
2-12" 45° BEND, MJ
8" WAS
12" DIP AIR PIPING
U.V. DISINFECTION
2 - 18" 45° BEND, MJ
2 - 8" 45° BEND, MJ
18" EFFLUENT
18" 90° BEND, MJ
BLOWER BUILDING
2 - 12" 45° BEND,MJ
POLYMER FEED
18" SECONDARY EFFLUENT
SODIUM BISULFITE FEED
1-18" 90° BEND, FL
2-18" 90° BEND, MJ
CHLORINE FEED
POLY ALUMINUM CHLORIDE FEED
PACKAGE PLANT No. 1
BLOWER BUILDING DRAIN
MH #D2
2" POTABLE WATER
DEWATERING BUILDING
MH #D3
DEWATERING BUILDING DRAIN
6" POTABLE WATER
6" TEE
6" POTABLE WATER SEE SHEET C-06 FOR CONTINUATION
8" 45° BEND, MJ
6" SLUDGE LINE
8" RECYCLE FORCEMAIN
10" FORCEMAIN
10" 45° BEND, MJ
24" FORCEMAIN
24" 45° BEND, MJ
18" DRAIN TO REJECT POND
PROPOSED 6' HIGH FENCE
REJECT POND

## YARD PIPING PLAN 'B'
SCALE: 1" = 20'

0' 10' 20' 40' 60'
GRAPHIC SCALE
Scale: 1 Inch = 20 Ft.

**RECORD DRAWING**
The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.

GEORGIA REGISTERED PROFESSIONAL ENGINEER No. 24492 DAVID R. HATABIAN

WELKER & ASSOCIATES A Division of PBSJ
445 Manget Street Marietta, Georgia 30060
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| DATE | REVISION |
|---|---|
| | |

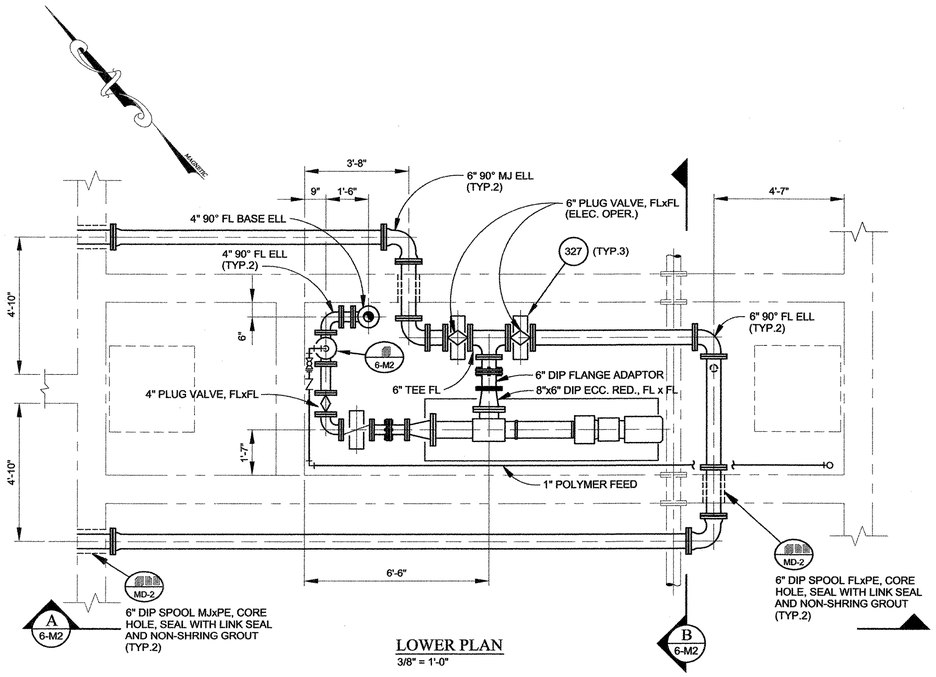
PROJ. NO: 732542.00
DESIGNED BY: D.R.H.
DRAWN BY: P.W.M.
CHECKED BY: D.R.H.
APPROVED BY: D.R.H.
DATE: APRIL 2005
SCALE: 1"=20'

CHEROKEE COUNTY WATER & SEWER AUTHORITY
FITZGERALD CREEK EXPANSION TO 2.0 MGD

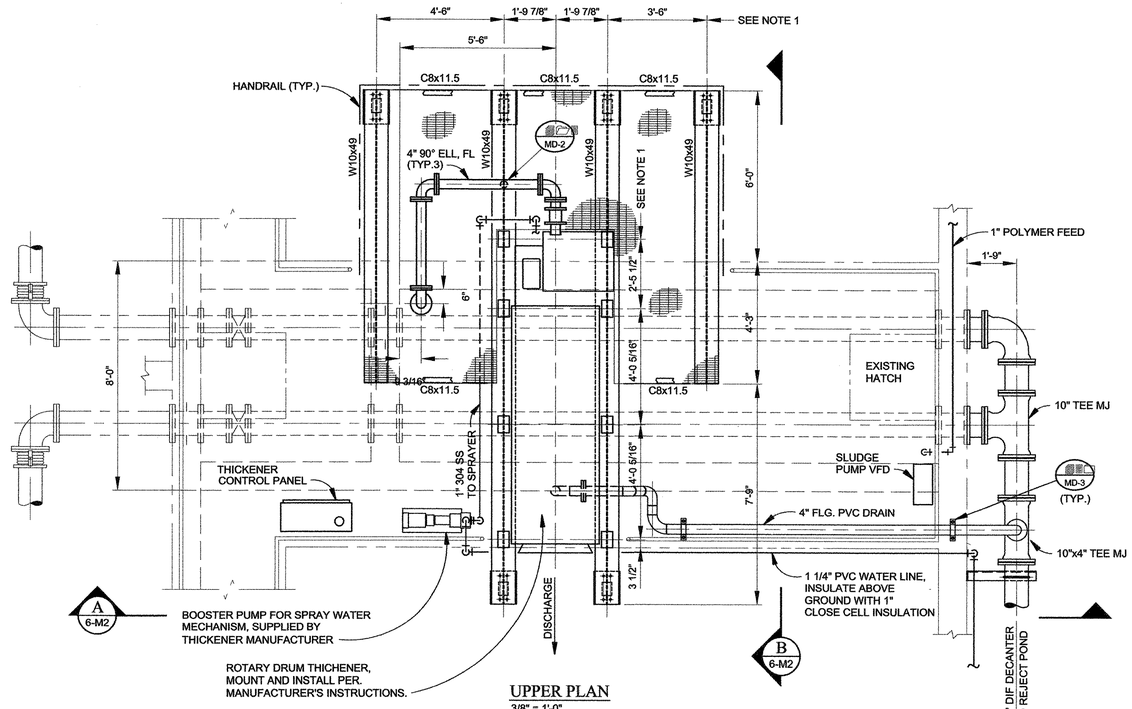
# YARD PIPING PLAN "A" & "B"

SHEET NO.
C-08
732542.00

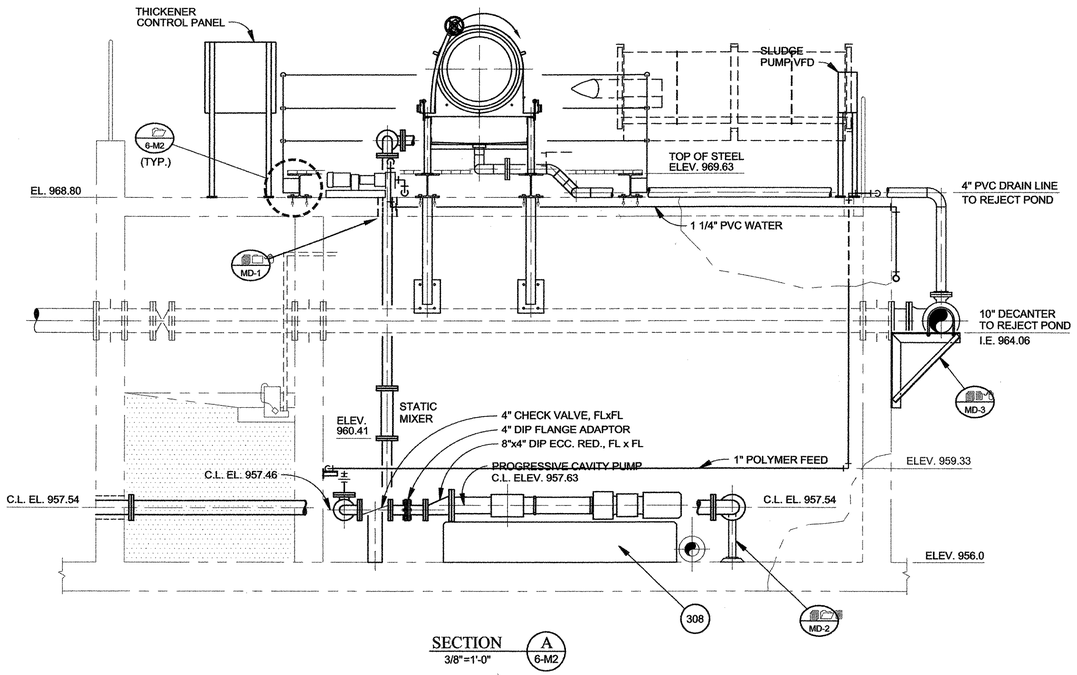
File Name: X:\02-542\0700 RECORD DRAWINGS\C-08 YARD PIPING.DWG|Tab:C-8|Plotted: June 09, 2005 2:56pm



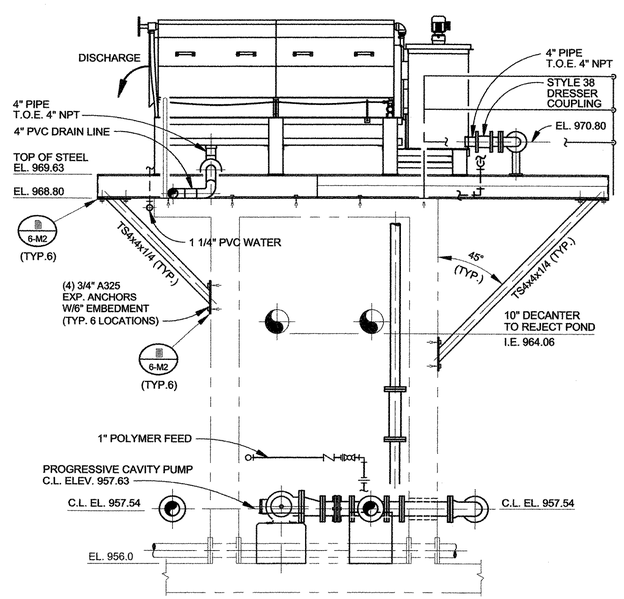

LOWER PLAN
3/8" = 1'-0"



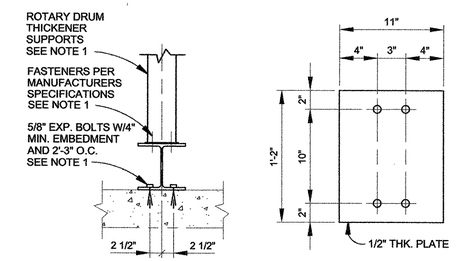

UPPER PLAN
3/8" = 1'-0"




SECTION A
3/8"=1'-0"

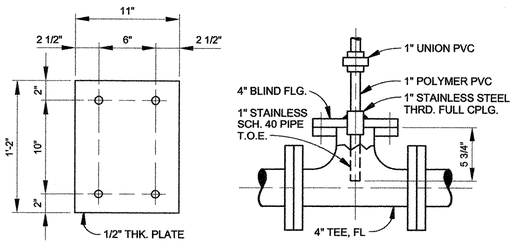



SECTION B
3/8"=1'-0"




DETAIL 1
3/4"=1'-0"
6-M2

DETAIL 2
1 1/2"=1'-0"
6-M2




DETAIL 3
1 1/2"=1'-0"
6-M2

DETAIL 4
1 1/2"=1'-0"
6-M2

# RECORD DRAWING

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.

NOTE:
1. CONTRACTOR TO COORDINATE BEAM LOCATIONS AND BEAM MOUNTING HOLES WITH THICKENER MANUFACTURER.


GEORGIA REGISTERED No. 24460 PROFESSIONAL ENGINEER DAVID R. HATABIAN

WELKER & ASSOCIATES
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445 Manget Street Marietta, Georgia 30060
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| REVISION | DATE |
|---|---|
| | |

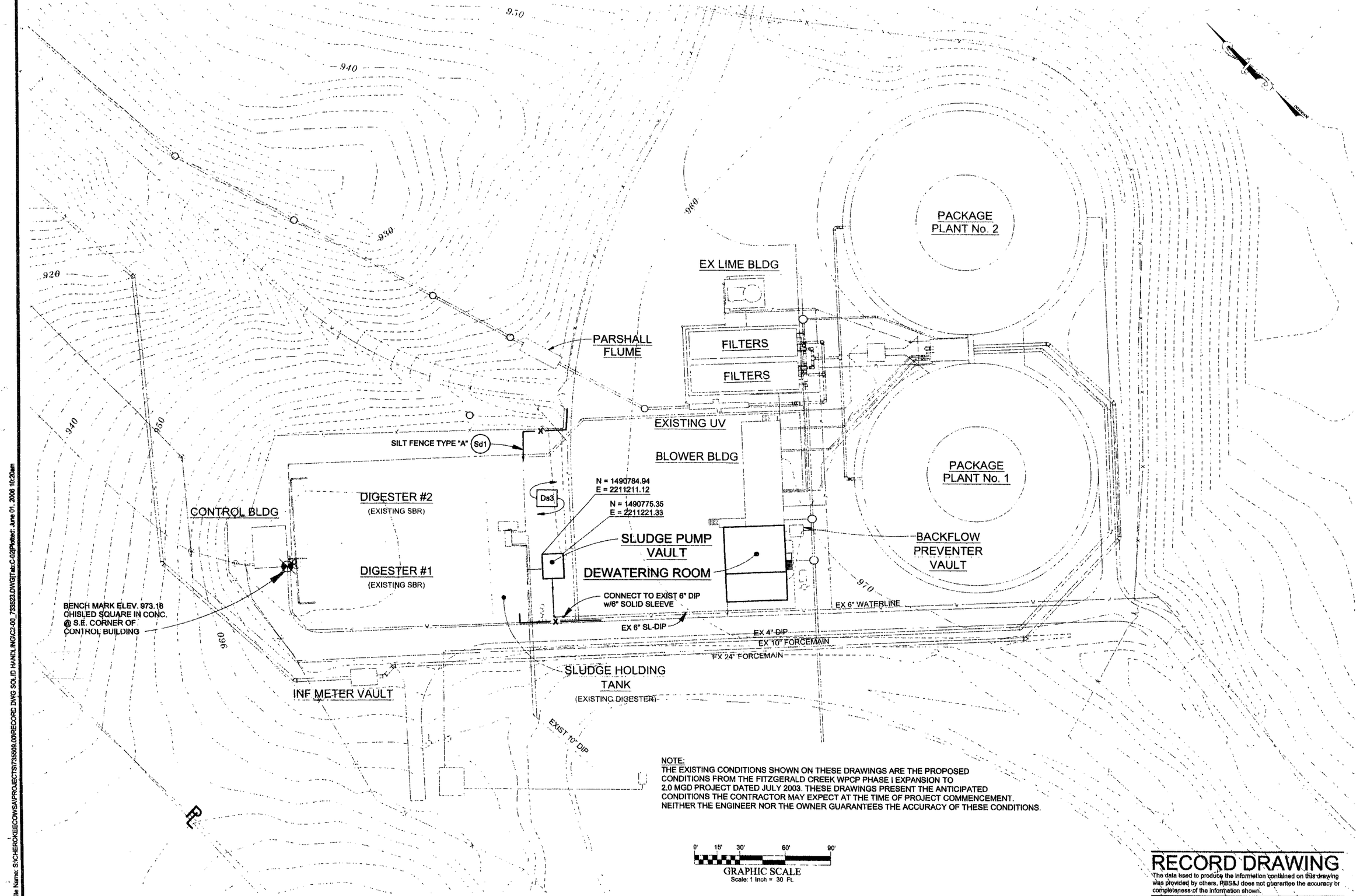
| | |
|---|---|
| PROJ. NO: | 732542.00 |
| DESIGNED BY: | CKH |
| DRAWN BY: | DTT |
| CHECKED BY: | DRH |
| APPROVED BY: | JGC |
| DATE: | APRIL 2005 |
| SCALE: | AS SHOWN |

CHEROKEE COUNTY WATER & SEWER AUTHORITY
FITZGERALD CREEK EXPANSION TO 2.0 MGD

# SLUDGE THICKENER PLANS, SECTIONS AND DETAILS

SHEET NO.
6-M2
732542.00

File Name: X:\02-5420\700 RECORD DRAWINGS\6-M2.DWG|Tab:6-M2|Plotted: June 27, 2005 10:21am




NOTE:
THE EXISTING CONDITIONS SHOWN ON THESE DRAWINGS ARE THE PROPOSED CONDITIONS FROM THE FITZGERALD CREEK WPCP PHASE I EXPANSION TO 2.0 MGD PROJECT DATED JULY 2003. THESE DRAWINGS PRESENT THE ANTICIPATED CONDITIONS THE CONTRACTOR MAY EXPECT AT THE TIME OF PROJECT COMMENCEMENT. NEITHER THE ENGINEER NOR THE OWNER GUARANTEES THE ACCURACY OF THESE CONDITIONS.

0' 15' 30' 60' 90'
GRAPHIC SCALE
Scale: 1 Inch = 30 Ft.

**RECORD DRAWING**
The data used to produce the information contained on this drawing was provided by others. RBS&J does not guarantee the accuracy or completeness of the information shown.


GEORGIA REGISTERED No. 24455 PROFESSIONAL ENGINEER DAVID R. HATABIAN

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| DATE | REVISION |
|---|---|
| | |

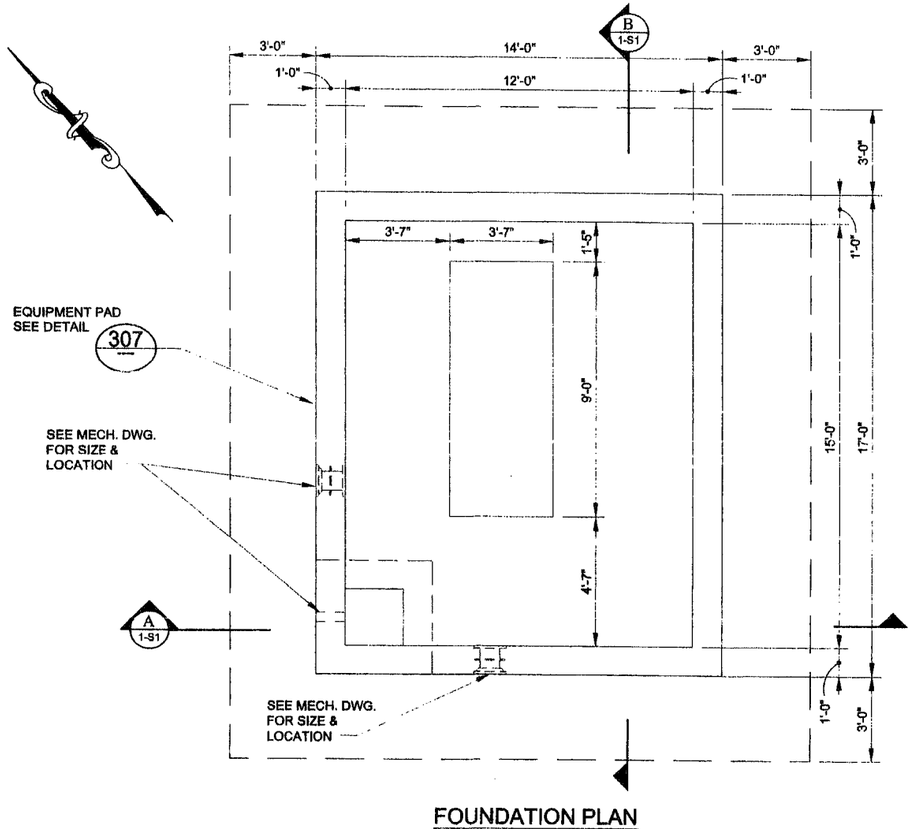
PROJ. NO.: 733523.00
DESIGNED BY: CRC
DRAWN BY: LBW
CHECKED BY:
APPROVED BY:
DATE: SEPT 2004
SCALE: 1"=20'

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

# PROPOSED SITE PLAN

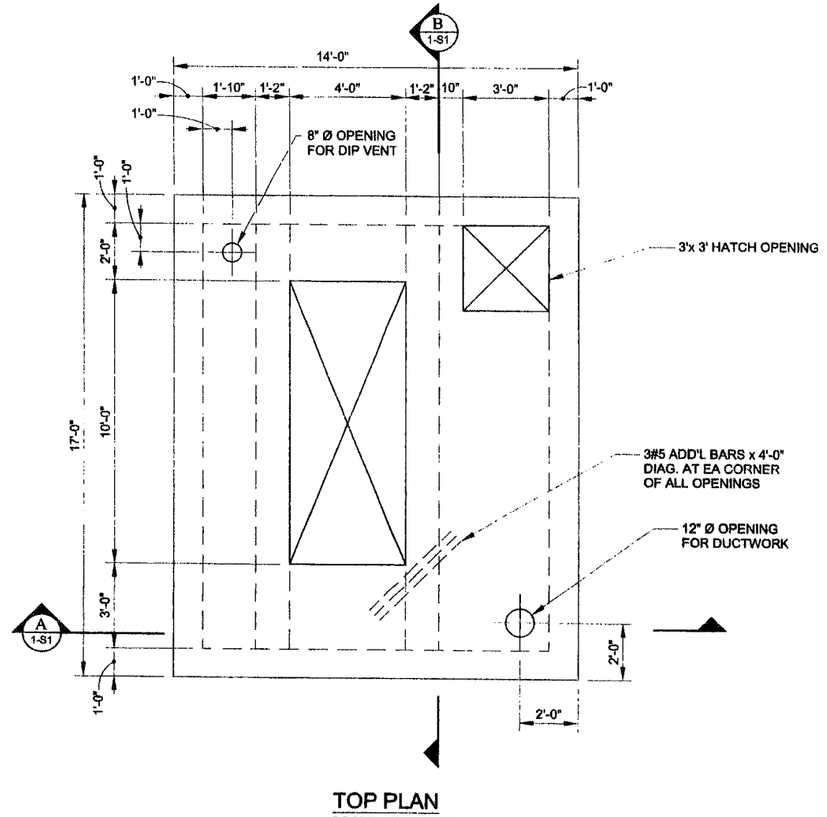
SHEET NO.
C-02
733523.00


File Name: S:\CHEROKEECOWSA\PROJECTS\735509.00\RECORD DWG SOLID HANDLING\C2-00_733523.DWG[TabC-02]Plotted: June 01, 2006 10:20am



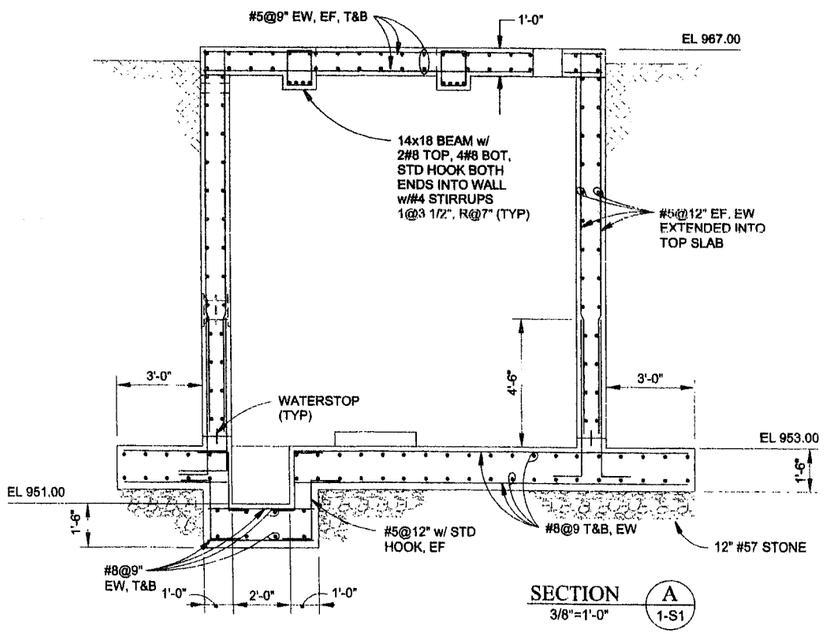

## FOUNDATION PLAN

SCALE: 3/8" = 1'-0"



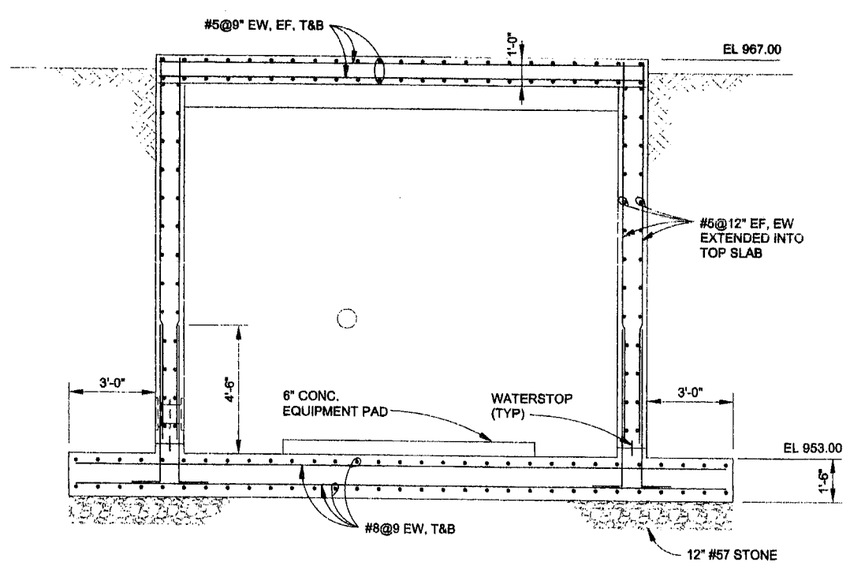

## TOP PLAN

SCALE: 3/8" = 1'-0"




## SECTION A

3/8"=1'-0" (1-S1)




## SECTION B

3/8"=1'-0" (1-S1)

**RECORD DRAWING**

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.

GEORGIA REGISTERED No. 29309 PROFESSIONAL ENGINEER ROBERT A. WARR

WELKER & ASSOCIATES
A Division of PBSJ
445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316

| DATE | REVISION |
|---|---|
| | |

| | |
|---|---|
| PROJ. NO.: | 733523.00 |
| DESIGNED BY: | RAW |
| DRAWN BY: | LBW |
| CHECKED BY: | RAW |
| APPROVED BY: | |
| DATE: | SEPT 2004 |
| SCALE: | AS SHOWN |

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

# SLUDGE PUMP VAULT PLANS AND SECTIONS

SHEET NO.
1-S1
733523.00

File Name: S:\CHEROKEECOWSA\PROJECTS\735509.00\RECORD DWG SOLID HANDLING\S1-01_733523.DWG[Tab:Layout1]Plotted: June 01, 2006 10:19am

EXISTING DIGESTER #1
(TO BE ABANDON)

EXIST. DECANTER

C 1-M3

EXISTING DIGESTER #1

EXIST. SLUDGE PUMP #1 (SEE NOTE 1)

CORE DRILL HOLE FOR 6" PLUG VALVE OPERATOR IN WALKWAY

1'-6"

CONNECT TO EXIST 3" PVC w/3" 90° BEND AND ROUTE NEW 3" PVC AS SHOWN

6" DIP

B 1-M2

A 1-M2

CONNECT TO EXIST 6" DIP FLG

6'-0"

F 1-M3

6'-8"

SLUDGE THICKENER NOT SHOWN FOR CLARITY

EXIST. 6" DIP

CORE DRILL TROUGH EXIST VAULT WALLS

EXIST. SLUDGE PUMP #2 (SEE NOTE 1)

3" PVC 90° BEND TURNED DOWN

SAW CUT EXIST 6" DIP

8'-0"

15'-6"

EXIST 3" PVC

EXIST VB FOR MUD VALVE

EXIST. DECANTER

3'x3' SLUICE GATE (G-101)

1'-6"

1'-6"

G 1-M3

EXISTING DIGESTER #2

SLUDGE HOLING TANK #1
(EXISTING DIGESTER #2)

24'-7"

REMOVE EXISTING PIPE

INSTALL 6" BLIND FLANGE

10" DIP

TO HOLDING POND

D 1-M3

E 1-M3

ALUM LADDER 310

8" MJxFLG WALL PIPE TAPPED FOR STUDS 400

PUMP (P-101)

10" DIP

8" PLUG VALVE

PIPE SUPPORT 402

6" SOLID SLEEVE

8" SL-DIP

8"x6" 90° SL-DIP

8" FLGxFLGxMJ WALL PIPE TAPPED FOR STUDS

6" MEGA- FLG KIT (TYP 2)

1'-0"

6'-8"

3/4" PVC SUMP PUMP DISCHARGE

1'-0"

2'-0"

SUMP PUMP 406

6" PLUG VALVE, MJ

12" FRP DUCT

6" MJxFLG WALL PIPE TAPPED FOR STUDS 400

6'-0"

6" SL-DIP

6" SOLID SLEEVE

TO DEWATERING BUILDING

6" 90° BEND (MJ)

3'x3' FLOOR HATCH

8" DIP VENT 411

1 1/2" ALUM SOLID PLANK GRATING w/EMBEDDED ANGLE 309

VENTILATOR FAN (VF-101) 410

2'-0"

2'-0"

## SLUDGE PUMP VAULT TOP PLAN

SCALE: 1/4" = 1'-0"

## RECORD DRAWING

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.

GEORGIA REGISTERED No. 24468 PROFESSIONAL ENGINEER DAVID R. HATABIAN

WELKER & ASSOCIATES
A Division of PBSJ
445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316

| REVISION | DATE |
|---|---|
| | |

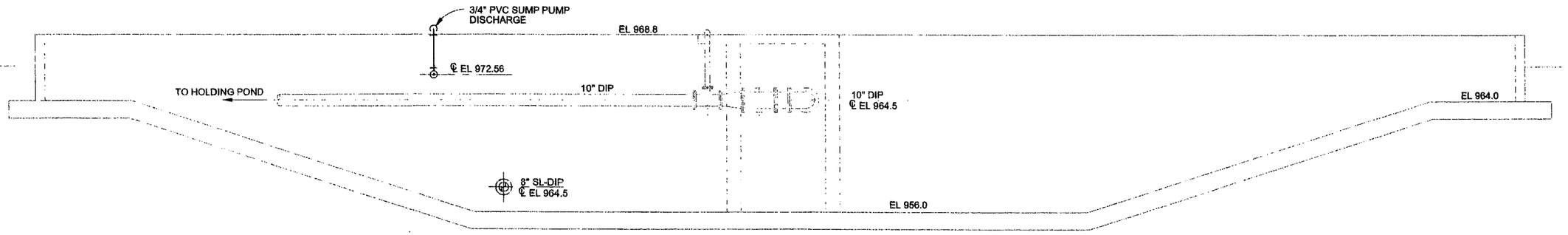
PROJ. NO.: 733523.00
DESIGNED BY: CRC
DRAWN BY: LBW
CHECKED BY:
APPROVED BY:
DATE: SEPT 2004
SCALE: 1/4" = 1'-0"

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

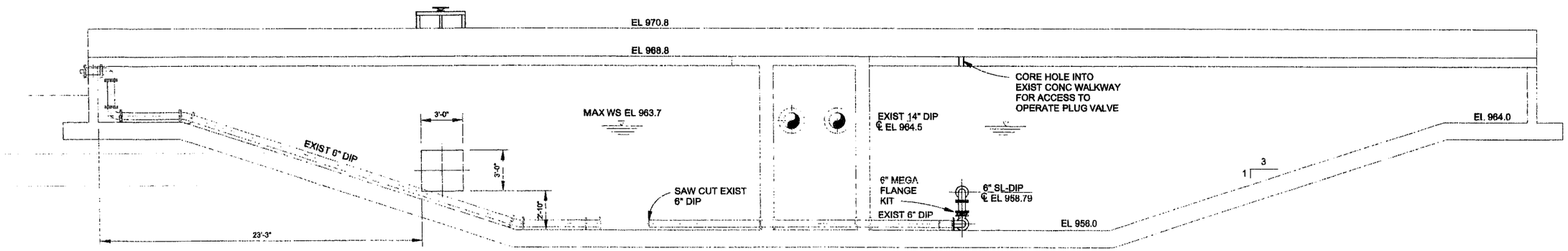
# SLUDGE PUMP VAULT AND BASIN MODIFICATIONS PLANS

SHEET NO.
1-M1
733523.00

File Name: S:\CHEROKEE\DWGS\PROJECTS\733523.00\RECORD DWG SOLID HANDLING\M1-01_733523.DWG | Tab: Layout1 | Plotted: June 01, 2006 10:18am




SECTION A
1/4"=1'-0"
1-M1




SECTION B
1/4"=1'-0"
1-M1

RECORD DRAWING
The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.

GEORGIA REGISTERED No. 24455 PROFESSIONAL ENGINEER DAVID R. HATABIAN

WELKER & ASSOCIATES A Division of PBS&J
445 Mangel Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316

DATE | REVISION | △

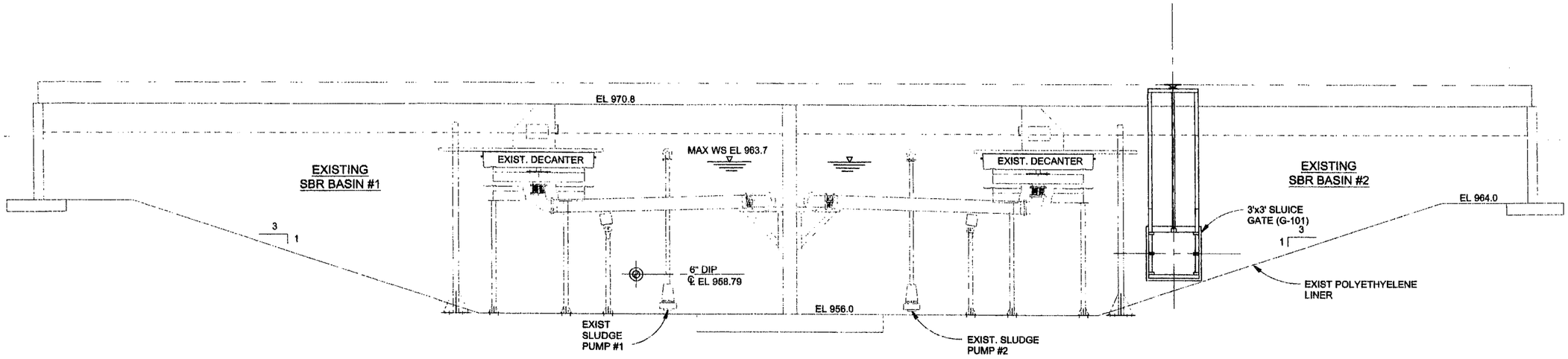
PROJ. NO.: 733523.00
DESIGNED BY: CRC
DRAWN BY: LBW
CHECKED BY:
APPROVED BY:
DATE: SEPT 2004
SCALE: AS SHOWN

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

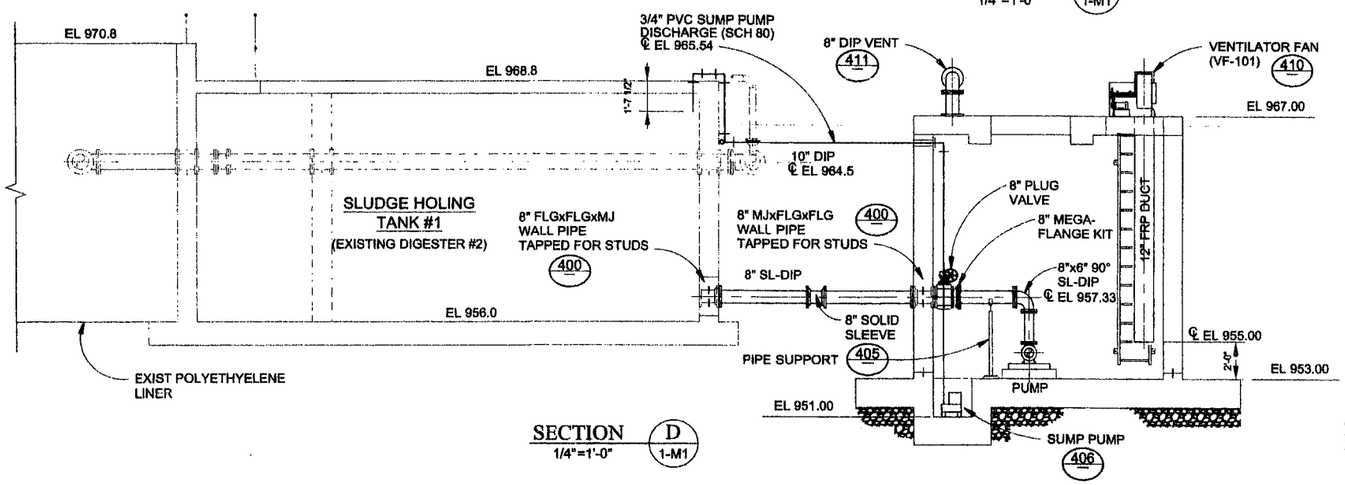
# SLUDGE PUMP VAULT AND BASIN MODIFICATIONS SECTIONS

SHEET NO.
1-M2
733523.00

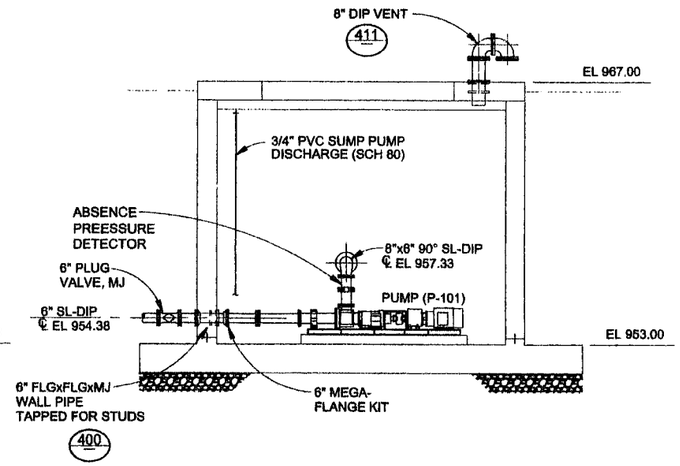
File Name: S:\CHEROKEECOWSA\PROJECTS\733509.00\RECORD DWG SOLID -HANDLING\M2-01_733523.DWG[Tab:Layout1]Plotted: June 01, 2006 10:18am



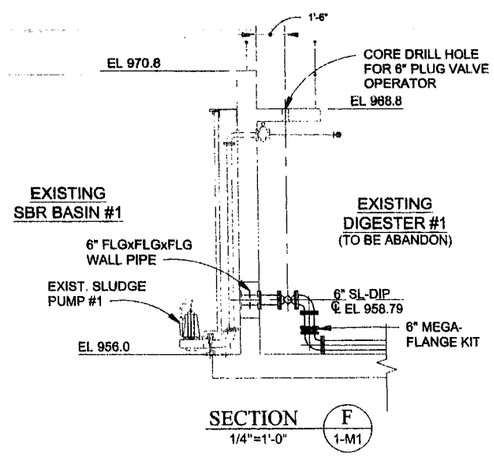

SECTION C
1/4"=1'-0" 1-M1



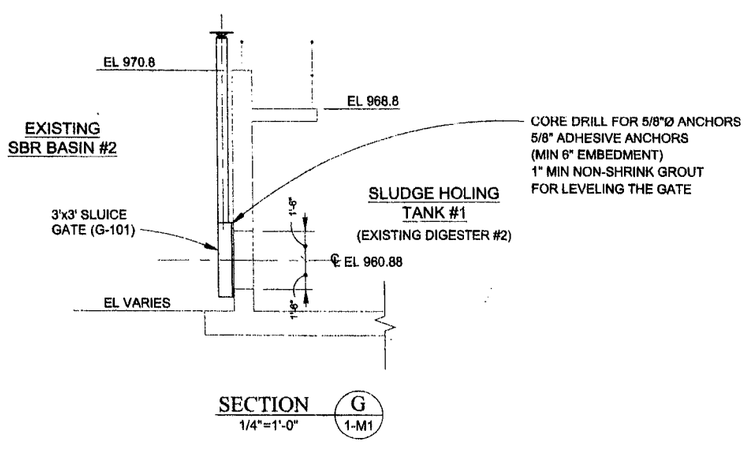

SECTION D
1/4"=1'-0" 1-M1




SECTION E
1/4"=1'-0" 1-M1




SECTION F
1/4"=1'-0" 1-M1




SECTION G
1/4"=1'-0" 1-M1

NOTES:

1. CONTRACTOR TO CLEAN BASINS BEFORE BEGINNING WORK. CLEANING MUST BE COORDINATED WITH PLANT MANAGER OR CONSTRUCTION COORDINATOR.

2. DURING INSTALLATION OF SLUICE GATE, CONTRACTOR SHALL REPAIR BASIN LINER AT HIS OWN COST.

3. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING ELEVATIONS.

**RECORD DRAWING**
The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.

GEORGIA REGISTERED No. 24455 PROFESSIONAL ENGINEER DAVID R. HATABIAN

WELKER & ASSOCIATES
A Division of PBSJ
445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316

| DATE | REVISION | △ |
|---|---|---|
| | | |

| | |
|---|---|
| PROJ. NO.: | 733523.00 |
| DESIGNED BY: | CRC |
| DRAWN BY: | LBW |
| CHECKED BY: | |
| APPROVED BY: | |
| DATE: | SEPT 2004 |
| SCALE: | AS SHOWN |

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

# SLUDGE PUMP VAULT AND BASIN MODIFICATIONS SECTIONS

SHEET NO.
1-M3
733523.00

File Name: S:\CHEROKEE\COWSA\PROJECTS\733509.00\RECORD DWG SOLID +ANDJINGM3-01_733523.DWG[Tab:Layout1]Plotted: June 01, 2006 10:17am

EXIST. DECANTER

EXISTING DIGESTER #1

EXIST. SLUDGE PUMP #1

EXISTING SBR BASIN #1

THICKENER NOT SHOWN FOR CLARITY

3'-4" NOTE 2

EXIST. SLUDGE PUMP #2

EXIST VB FOR MUD VALVE

EXIST. DECANTER

3'x3' SLUICE GATE

EXISTING DIGESTER #2

EXISTING SBR BASIN #2

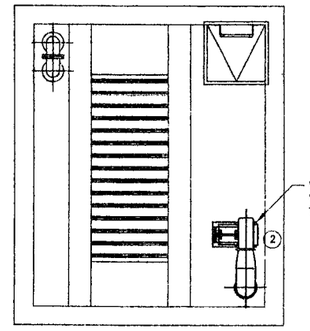
D 1-M3

UH-2 (1)

TO HOLDING POND

TO DEWATERING BUILDING

| HVAC NOTES (APPLY TO THIS DRAWING ONLY) |
|---|
| (1) INSTALL BOTTOM OF UNIT HEATER MIN. 7'-0" AFF. DISCHARGE DOWN AT A 45° ANGLE. WALL MOUNTED. UNIT MOUNTED THERMOSTAT SET TO 50°F. |
| (2) 12 " Ø FRP DUCT DOWN TO 24" A.F.F. OPEN AT BOTTOM. FAN SHALL RUN AUTOMATICALLY WHEN THE HATCH IS OPEN. |




SLUDGE PUMP VAULT TOP PLAN

## RECORD DRAWING

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.


GEORGIA REGISTERED No. 17873 PROFESSIONAL ENGINEER MICKEY D. GREGG

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A Division of PBSJ
445 Manget Street Marietta, Georgia 30060
P: 770.422.1902 F: 770.426.5316


| REVISION | DATE |
|---|---|
| | |

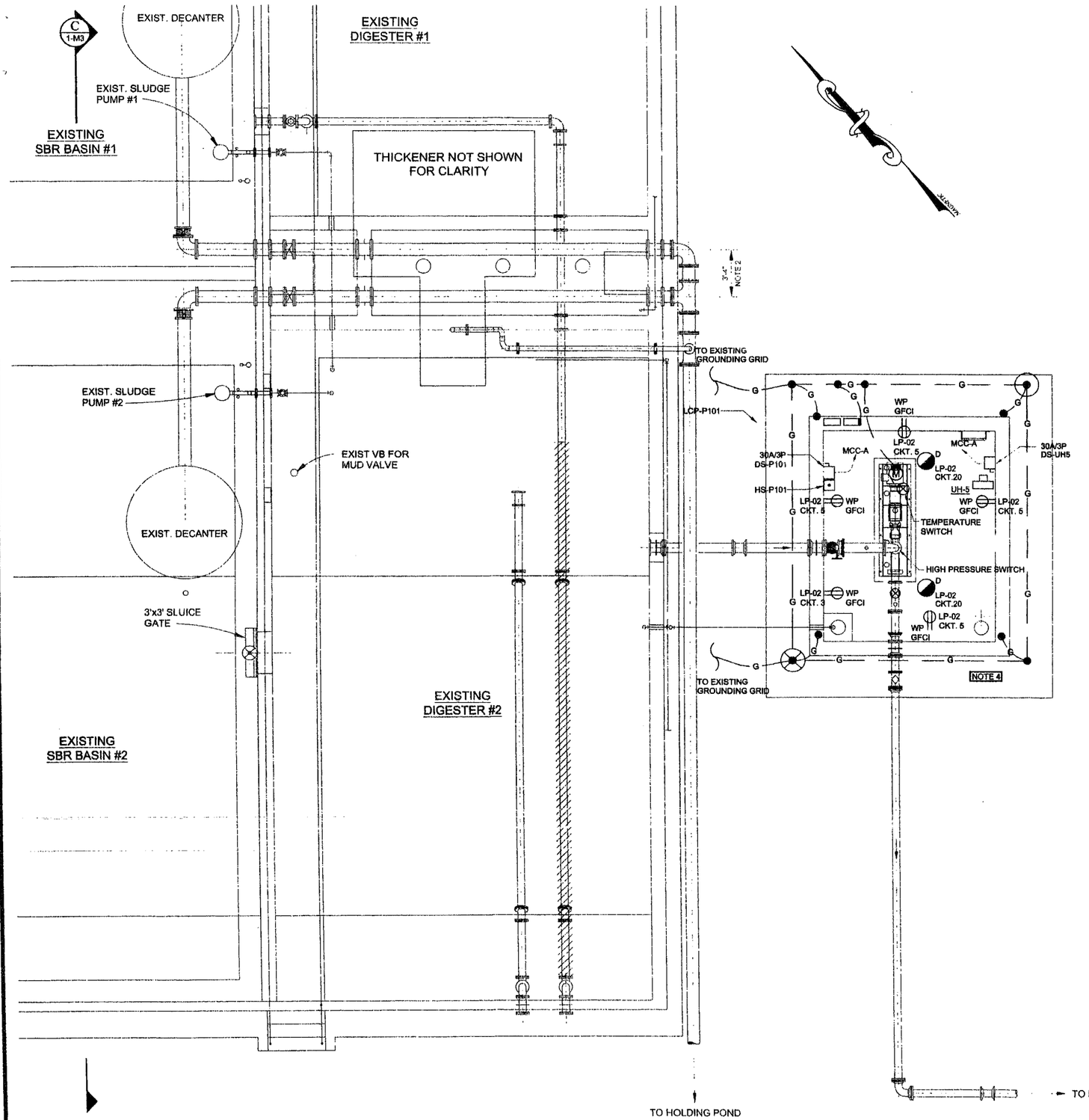
PRC.J. NO.: 733523.00
DESIGNED BY: MDG
DRAWN BY: AK
CHECKED BY: MDG
APPROVED BY: KSM
DATE: JULY 22, 2004
SCALE: 1/4" = 1'-0"

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

# SLUDGE PUMP VAULT HVAC PLAN

SHEET NO.
1-H1
733523.00

File Name: S:\CHEROKEECOWSA\PROJECTS\733509.00\RECORD DWG SOLID HANDLING\HVAC\H1-1 SLUDGE PS.DWG[Tab:Layout1(Plotted: July 06, 2006 8:59am



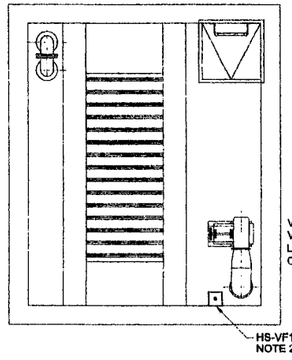

NOTES:

1. ALL SWITCHES AND PANEL IN THE VAULT SHALL BE IN WEATHER PROOF ENCLOSURE.

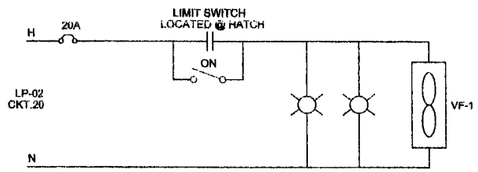
2. 20A/1P HORSE POWER RATED TOGGLE SWITCH IN WEATHER PROOF ENCLOSURE SS316, MOUNT ON UTILITY RACK.

3. PROVIDE TWO NEMA 4X JUNCTION BOX IN THE SLUDGE VAULT TO TERMINATE ALL 480V & 120V CABLES ONE EACH. BOX SHALL BE SIZED PER NEC.

4. ALL THE EQUIPMENT IN THE SLUDGE VAULT SHALL BE NEMA 4X.




## SLUDGE PUMP VAULT TOP PLAN




LIMIT SWITCH CLOSES WHEN THE HATCH IS REMOVED

## VENTILATION FAN CONTROL DIAGRAM

**RECORD DRAWING**

The data used to produce the information contained on this drawing was provided by others. PBS&J does not guarantee the accuracy or completeness of the information shown.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| REVISION | DATE |
|---|---|
| | |

PROJ. NO.: 733523.00
DESIGNED BY: PT
DRAWN BY: AK
CHECKED BY: AKR
APPROVED BY:
DATE: AUGUST 2004
SCALE: 1/4" = 1'-0"

CHEROKEE COUNTY
WATER & SEWERAGE AUTHORITY
FITZGERALD CREEK WPCP SOLID HANDLING

# SLUDGE PUMP VAULT LIGHTING, POWER & GROUNDING PLAN

SHEET NO.
1-E1
733523.00

File Name: S:\CHEROKEE\OWS\A\PROJECTS\733509.00\RECORD DWG SOLID HANDLING\ELECTRICAL ASBUILT RECORDE\1-1 RECORD SLUDGE PS.DWG[Tab:Layout1]Plotted: July 05, 2006 8:40am